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THE DEVELOPMENT OF A NORMATIVE ACQUISITION DECISION MAKING MODEL INCORPORATING DECISION ANALYSIS PRINCIPLES

THESIS

Thomas M. Parsons
Captain, USAF

AFIT/GLM/LSM/87S-54

DEPARTMENT OF THE AIR FORCE
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Wright-Patterson Air Force Base, Ohio

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THESIS

Presented to the Faculty of the School of Systems and Logistics
of the Air Force Institute of Technology
Air University
In Partial Fulfillment of the
Requirements of the Degree of
Master of Science in Logistics Management

Thomas M. Parsons, B.S.
Captain, USAF

September 1987

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Preface

The process of coordinate and compromise is a central, but misunderstood, feature of Air Force management. Although Air Force civilian and military managers alike are trained from the very beginning of their careers to become proficient in the mechanics of the coordination process, the full implication of what it means to the organization as a whole is often overlooked. The inescapable facts are that the Air Force is a very large organization and that it must make decisions and act upon those decisions to be effective. To accomplish the functions of deciding and acting requires a consensus, or agreement, between the key participants. To reach this consensus, in turn, requires the communication of information.

In an individual, lucid thought and decisive action are perceived of as positive personal qualities. In a large organization, however, those same qualities can be viewed instead as recklessness and naivete'. Thus, the task of making explicit all information affecting an issue is usually resisted and generally underappreciated. The results are that the information used in decision making is often not coherent, that communication processes are clouded with ambiguity and misunderstandings, and that the ultimate outcome of the decision process rests more on chance than reason.

The genesis of this topic was my experience as an acquisition program manager. While successful program managers may already practice some of what is discussed in this study, for others, like me, the system sometimes seemed to present an endless array of

hurdles. This study was my attempt to understand that. If what I have learned is of some help to another program manager the study will have been, for me, a success.

For all the positive aspects of this research, and none of the mistakes, I am indebted to several individuals. While at the F-16 System Program Office, Colonel Bartow Tucker and Lieutenant Colonel Joe Banks provided me with an "on-the-job" unsurpassed education in Air Force decision making. I thank them for their enthusiasm and patience. At the Air Force Institute of Technology, I must thank two of my teachers. First, Captain Joe Tatman, who exposed me to the principles and techniques of decision analysis and struggled to help me understand and apply them. Second, Major Larry W. Emmelhainz, who as both a teacher and as my thesis advisor, worked hard to help me transform my many ideas into focused academic research.

At home, I must first acknowledge the many contributions of my parents, Bev and Vince. Their help in keeping the household running and in supporting my endeavors is greatly appreciated. For my wife Sue, my sincerest love and affection for providing me unfaltering encouragement. Her critical ear and positive outlook kept me solidly on course during the last eight months. And finally, to my sons Mark and Richard, thank you for being there, for a look at your faces always reminded me what it was all about.

Thomas M. Parsons

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ABSTRACT

Program managers are faced with the task of integrating a complex mix of goals, objectives and procedures from four sub-processes within the major weapon system acquisition process. These sub-processes include needs determination, budget, acquisition management, and contracts. This complexity is compounded by the dual roles of the program manager: traditional manager coupled with primary program advocate.

To be effective in this organizational situation, the program manager requires a framework to efficiently guide decision making efforts. This study developed a normative decision making model to guide program managers in dealing with this complexity. The model, based upon management theory, focused on information generation and communication tasks. It was then compared to the Air Defense Fighter Competition decision.

Decision analysis techniques were integrated into the model to structure the decision making process to efficiently generate relevant information in a form to maximize its utility to the organization as a whole.

The case study evaluated Air Defense Fighter program documentation to ascertain applicability of the model. Analysis showed that a valid normative model can be developed for use by a

program manager working in a bureaucratic organization; that the various sub-processes generated some of the information required by decision analysis techniques, but that information regarding organizational values and assessments of future uncertainty and risk were not used or requested; that coordinating activities were a critical part of efforts to reach consensus concerning goals, objectives, etc.; and that the four sub-processes did not, in and of themselves, provide an overall coherent decision making structure.

Recommendations were that the Air Force undertake training initiatives in organizational decision making, that program managers be required to structure decision making activities to generate and document information in accordance with the normative model and that methods to explicitly consider value, uncertainty and risk be studied and implemented.

THE DEVELOPMENT OF A NORMATIVE ACQUISITION DECISION MAKING MODEL INCORPORATING DECISION ANALYSIS PRINCIPLES

I. Introduction

The Air Force acquisition Program Manager must make resource allocation decisions in an organizational situation characterized by complex procedural directives while facing an uncertain and changing environment. To accomplish this task, the Program Manager must effectively employ information search and communication skills. While untried in group process decision making, decision analysis principles and techniques offer the opportunity for the Program Manager to efficiently focus acquisition decision making activities.

This introductory chapter reviews the acquisition decision making environment, the current status of policy as regards major weapon system acquisitions, and a brief overview of existing management tools used to support management decision making. The chapter goes on to provide a problem statement, justification for the research and the research approach followed in this study.

The Defense Acquisition Environment

Facing little or no real budget growth for Fiscal Years 1988 and 1989, and the possibility of Gramm-Rudman deficit reduction cuts (CBO, 1987: 38), Air Force acquisition managers in 1986 were under close cost, schedule and performance scrutiny. This pressure was seen in the increased interest that military acquisition was receiving as a result of media attention. During the last several years the news media has reported on the "spare parts folly" (Bernstein, 1984: 123) and the inherent management inefficiencies of the "military-Congressional complex" (Fossedal, 1985: 22). In each case attention was directed at how the government managed its military acquisitions.

The government agencies responsible for the management of the military responded to these concerns. In testimony before the Congress in February 1986, Secretary of Defense Casper W. Weinberger stated that a major priority of the new Defense budget was good management (Weinberger, 1986: 19). Good management in this context focused on the process of Defense management, not just its outcomes. Given such demands, the quality of the acquisition decision making process became increasingly critical.

In addition, President Reagan's Blue Ribbon Commission on Defense Management (the Packard Commission) concluded that significant changes were required to improve the overall effectiveness of management processes in the Department of Defense (DOD). One of its four main recommendation areas concerned the acquisition of weapon systems. The Commission's recommendation dealt with the

manner in which the acquisition process could be made more effective and efficient, in a business sense, and thus result in a better product at less cost to the taxpayers (President's..., 1986: xxiv-xxvii).

Acquisition Policy

Effective and efficient management of the weapon system acquisition process was not, however, first identified by the Packard Commission. A 1969 pamphlet published by the DOD Defense Systems Management College (DSMC), explored the nature of the acquisition program manager's (PM) management role in depth. The PM's stated role was

> ... to tie together, to manage, to direct the development and production of a system meeting performance, schedule, and cost objectives which are defined by his Service and approved by the Secretary of Defense (SECDEF) (DSMC, 1969: 2).

To accomplish this task, the PM must effectively create a 'program balance' to efficiently reconcile all operational requirements and resource constraints having an impact upon the program (DSMC, 1969: 7).

DOD policy directives on the acquisition of major weapon systems echoed this tasking for the program manager. In Department of Defense Directive 5000.1, Major System Acquisitions, the program manager was given the principle and objective of achieving a "cost-effective balance" between the life cycle costs of the system and its mission effectiveness (DOD, 1986: 2). Numerous other examples of

regulatory guidance were in place which defined the ways that a PM must deal with programmatic and technical issues. These guidelines came from all corners of the government including the Congress, the Office of Management and Budget (OMB), the Offices of the Secretaries of Defense and Air Force, the Headquarters Air Force staff, and the major commands.

The OMB, for example, has directed that acquisition program managers for each major system must "... ensure appropriate trade-off among investment costs, ownership costs, schedules, and performance characteristics" (OMB, 1976: 4). Air Force Regulation (AFR) 800-2, Acquisition Program Management, assigns to the PM the responsibility to "... make management decisions ... equally weighing cost, schedule, performance and supportability" (DAF, 1985: 6). Given the magnitude and complexity of the organizations with which the PM must deal, the success of those decisions is influenced by his or her ability to communicate effectively (Drucker, 1967: 66-67).

The Program Manager had come to assume a dual role. The PM was both a 'manager' and an 'advocate' for the program (Fox, 1974: 460). As the 'manager' of the program, the PM was responsible for matching program output to the larger organizational needs of the Air Force and managing the actual conduct of the program. The PM had to "... oversee the Department's effort to acquire, deploy, operate, and support major weapon systems of proven capability, within approved schedules and budgets" (Fox, 1974: 173). At the same time, as the program 'advocate', the Program Manager was

responsible for "... promot[ing] and defend[ing] his program before other levels of the Defense Department and before Congress" (Fox, 1974: 178). To defend the program, the PM had to project "unwavering optimism" to avoid program budget reductions that might jeopardize the program (Fox, 1974: 178, 180). This motivation of the Program Manager was compounded by perceptions that the promotion potential of the PM was enhanced by budgetary successes which avoided programmatic reductions (Kanter, 1979: 114 and Fox, 1974: 180).

In both of these roles, the Program Manager was forced to rely upon the efforts of others The PM was responsible for defining the program objectives and ensuring they were achieved. This implied "controlling and coordinating the work [of others] so that no one aspect dominate[d] others to the detriment of the harmony of the whole" (DSMC, 1969: 2). Therefore, part of this dual role as both the program's manager and its chief advocate, the most important function of the PM was said to be

> ... getting people to communicate with each other to achieve a common understanding of the needs of the program and their place in the harmony of the total program effort (DSMC, 1969: 2).

The practical objective of this communication effort was to ensure that the program proceeded as smoothly as possible by balancing the needs of the program with the needs of the larger organization. According to Wiener, "... communication is the cement that makes **organizations** [Emphasis in original]. Communication alone

enables a group to think together, to see together, and to act together" (Wiener, 1955: 40).

What is communicated by the PM is information. This information must first have been transformed from simple data to be useful to recipients. Information is created by selecting and structuring data with respect to a specific problem, user, time, and place (Ebert & Mitchell, 1975: 96; Schoderbek, et al, 1985: 153). A common formula states that when **A** communicates something with **B** then **X** is the result: **A** -» **B** ▪ **X** (Schoderbek, et al, 1985: 167-168). However, Thayer states that the information communicated is a product of the receiver as well as the sender (Thayer, 1968: 48-51).

As the Air Force has become more functionally specialized due to the increasing complexity of war fighting technology, staff managers have become more abundant and powerful (Harrison, 1978: 577-578). For the PM, as primarily a line manager (i.e. responsible for accomplishing core organizational tasks), the informational needs of the staff must then be taken into account to minimize intra-organizational conflict (Harrison, 1978: 587).

Unfortunately for the PM, the definition of what constitutes useful information can often vary depending on one's organizational perspective. For example, the staff organization at a headquarters will require 'information' that directly supports their specific responsibilities while the PM will want to provide 'information' that supports the immediate needs of the program (Fox, 1974: 175-176). When these points of view diverge, the communication skills of the PM are tested.

This situation is made more complex by the very nature of the system within which the Program Manager must work. Instead of a single process to manage, the PM is actually confronted with several contributing 'sub-processes' that feed the overall weapon system acquisition system (DAF, 1976: 1). Four critical sub-processes are determining requirements, budgeting, contracting and the overall managing of the acquisition program. The PM must ensure that the many functions required by these sub-processes are identified, tailored and augmented as needed, and "integrated into an overall management organization and approach that will ensure a successful acquisition effort to achieve program objectives" (DAF, 1976: 4).

What is required is to embue the information to be communicated with an unabiguous and precise meaning which is shared by both the sender and receiver while satisfying the procedural requirements of the various acquisition sub-processes. Ideally, to best serve the needs of the overall organization, an unbiased, structured, and objective decision making process is needed that provides the best available information (Harrison, 1978: 586-588 and Fox, 1974: 180). The Air Force currently lacks an overall framework to help the PM efficiently balance the various sub-process goals, objectives and rules.

Existing Management Tools

Many decision making systems have been provided to the Air Force PM over the years. These tools have been designed and

offered as the means to accomplish the data-to-information transformation process and to support subsequent communications. These tools have often been designed to provide specific answers to problems that can be easily quantified and subjected to computer analysis. Post World War II operations research tools (e.g. optimization techniques such as linear programming) were effective primarily with operationally repetitive problems. In the 1950's, management science developed to address high level management problems. These efforts, however, tended to focus upon problems that could be solved with elegant mathematics (Matheson and Howard, 1968: 21-22).

Optimization techniques and elegant mathematics required that simplifying assumptions be made concerning both the nature of the decision to be made and the operational characteristics of the system under examination. Three of the most significant assumptions were that an objective function could be formed containing a single attribute for evaluation, that outcomes were not subject to uncertainty (de Neufville and Stafford, 1971: 87) and that decision makers were utility maximizers (Simon, 1978: 2-6 and Simon, 1979: 498-499).

The same was true of computer simulations. These highly complex computer programs included many implicit and often subtle assumptions that affected data provided by the simulations (Shannon, 1975: 298-299). As program information was presented to groups further and further removed from the raw simulation data upon which they were originally based, the clarity of the intended

message, in terms of assumptions, limitations, and risks, was diminished (Simon, 1959: 265-273).

The assumptions employed in the tools of management science are necessary because the real world is complex and dynamic. Herbert Simon stated that even with these powerful new tools, "most real-life choices still lie beyond the reach of maximizing techniques - unless the situations are heroically simplified by drastic approximations " (Simon, 1959: 259). The real world and its problems are not simple and straight forward. They are messy. According to Howard Raiffa, there is an art rather than a science to analyzing real world problems. The 'art' required is the understanding of the decision maker's perceptions of the environment and how he or she manages the process of choice (Raiffa, 1968: 239).

What is needed then is a normative framework that allows the PM to bring together data and to efficiently transform the data into information in such a way that the PM can then effectively communicate the information to others. The tools of management science have not accomplished that task and organizational structure and formal procedures by themselves are insufficient. The principles and techniques of decision analysis, however, offer the opportunity to deal with these problems.

> Decision analysis includes procedures and methodology for assessing the real nature of a situation in which a decision might be made, for capturing the essence of that situation in a formal but transparent manner, for formally 'solving' the decision problem, and for providing in-

sight and motivation to the decision-makers and implementers (Howard and Matheson, 1983: viii).

For example, decision analysis principles and techniques were used to help evaluate alternatives in the early stages of the Mars exploration program. Decision analysis was beneficial in that it defined a simplified version of the decisions to be made, which then could be improved incrementally, into the more complex and realistic models needed to decide upon an actual mission. Different alternatives were defined and then two fundamental operations were performed: expectation and maximization. These helped determine, in the face of extreme complexity and uncertainty, the most economical decision (Matheson and Howard, 1968: 48).

Similarly, for acquisition Program Managers faced with increased scrutiny of their programs, decision analysis techniques could improve the quality of decision related information and thus increase the effectiveness of the communication process. Decision analysis principles directly address the two key issues in organizational decision making: efficient information generation and effective information communication. Ultimately, use of decision analysis techniques could potentially increase the defensibility of programmatic decisions as being rational, informed and consistent (Raiffa, 1968: 266-269).

Statement of the Problem

Current rules and procedures for decision making by acquisition Program Managers in the Air Force constitute a complex approach for allocating the resources under their control. This complexity has

resulted in a fragmentation of objectives and rules with which the PM must deal. This fragmentation affects the ability of the Air Force to efficiently choose a course of action and then to effectively defend or justify that choice to others. Efficiency requires a structured information generation process while effectiveness requires an explicit and unambiguous communication of relevant facts. The Air Force currently lacks an overall conceptual framework by which organizationally fragmented decision making rules and procedures can efficiently and effectively guide the PM. While decision analysis appears to offer a means of solving this problem, the technique has not been applied to situations analogous with that of the weapon system acquisition Program Manager.

Objective of the Study

The objective of this research is to provide better understanding of decision making processes in the Air Force acquisition arena in terms of the information generated and how that information is subsequently communicated to others and ultimately acted upon. Specifically, the intent of this study is to:

1. develop a normative decision making model for use in the weapon system acquisition management process which integrates decision analysis principles and procedures,

2. test this model against an actual program management decision, and

3. draw conclusions about the implementation of the model into acquisition management procedures.

Justification

The use of decision analysis techniques in conjunction with an overall normative decision making model can assist Air Force Program Managers in allocating the scarce resources of money, time, and manpower effectively and efficiently. Decision analysis inherently provides structure to data. This structure increases understanding of the problem and clarifies what decision is to be made, thus focusing the PM's decision making process. This focus should improve the ability of the PM to transmit decision information using available communication channels. Decision analysis principles help ensure that decisions are adequately defined, rationally consistent and defensible to others. To the extent that these principles can be used with the complex decisions and inter-related management processes faced by the PM, the overall management of the weapon system acquisition process should be improved.

Approach

The primary work necessary to accomplish the study objective is divided into two parts. First, in Chapter IV the results of the literature review are used to create a model of organizational decision making which incorporates the principles of decision analysis. This

model is intended as a general decision making framework and is called the Organizational Decision Analysis Model (ODAM).

Second, in Chapter V a review of a recent Air Force acquisition decision (the Air Defense Fighter Competition) is performed and the results compared to the basic attributes of the ODAM. The purpose of this comparison is to identify the extent to which the generalized model might be appropriate for, and improve decision making in, the specific organizational setting of the DOD weapon system acquisition process. The detailed methodology of this comparison is covered in Chapter III. Figure 1 summarizes the study approach and the products produced.

Summary

This chapter defined the problem to be studied as one concerned with the information used in the weapon system acquisition management process by the Program Manager. The use of this information in support of organizational decisions, and its communication to that end, are central to the research. The method used in the study encompasses stages described in terms of a two part approach. Chapter IV produces a generalized model (ODAM) based upon the results of the literature review. Chapter V then compares the ADF Competition to the major attributes of the ODAM. Finally, in Chapter VI the study is summarized and conclusions are drawn.

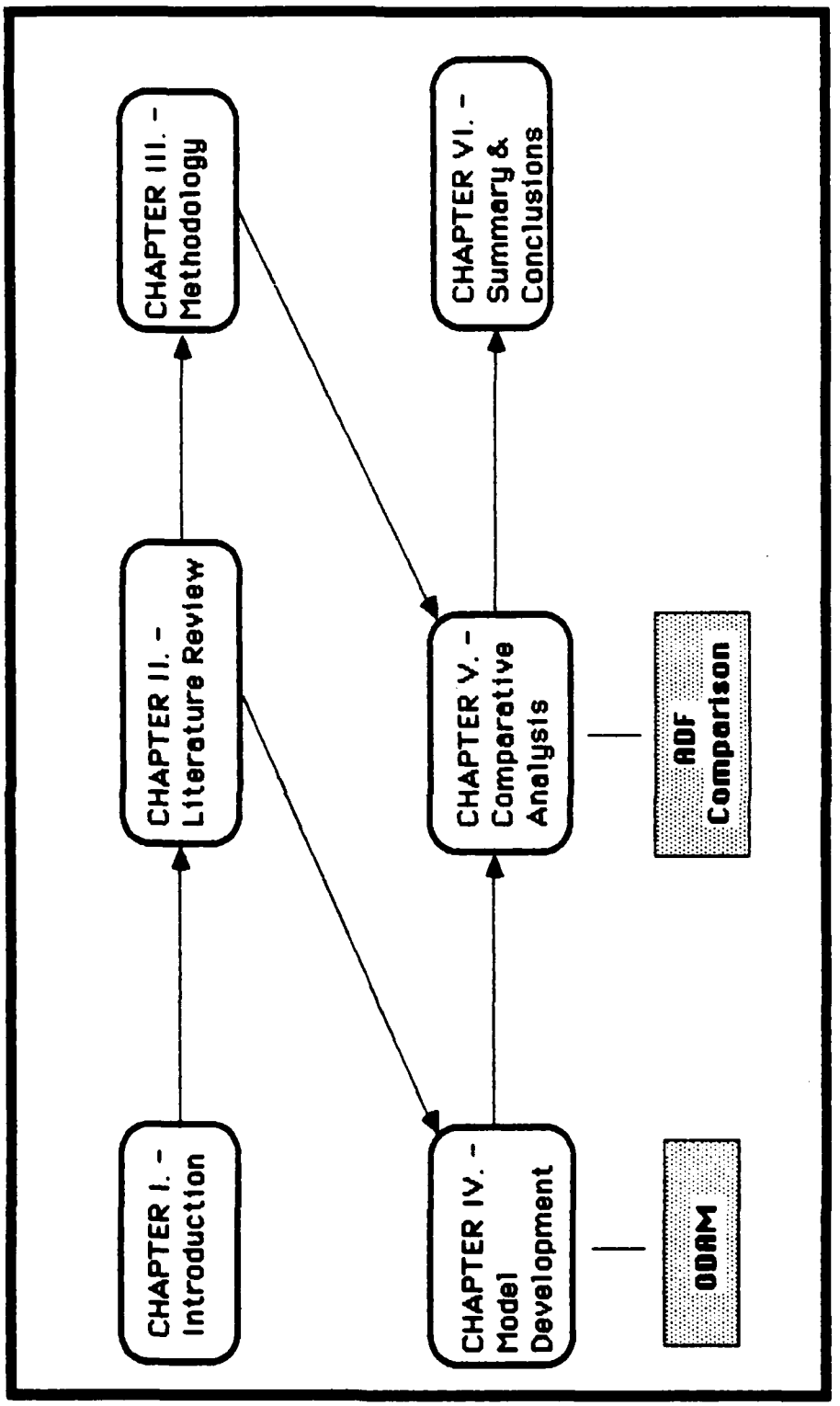

Figure 1

Approach

II. Literature Review

Introduction

The purpose of this chapter is to review the literature associated with the topic of organizational decision making in general and Air Force acquisition decision making in particular. The next section provides a broad background of decision making as a topic relevant to the study of management. In the third section, the DOD acquisition decision making structure and procedures are defined and the current acquisition environment is reviewed. This organizational structure is shown to be comprised of four independent, but inter-related, sub-processes. In the fourth section, management theory is reviewed as it relates to organizational decision making. The management theory section covers the overall decision making task in terms of organizational structure and organization effectiveness. There is also a discussion of three types of management organization and how these impact decision making. Finally, decision analysis is discussed, its approach defined in detail, and its major techniques briefly explained.

Background

The basic economic problem is to allocate, at a given point in time, relatively scarce resources among relatively infinite, and competing, culturally determined needs (Liebhafsky, 1968: 13). The managerial corollary is that rational resource allocation increases the

overall effectiveness of organizations by efficiently satisfying needs: that is, rational decision making provides for the productive utilization of resources (Drucker, 1974: 67). Insofar as managers affect action through organizations, the following observation by Baligh (1986: 1488) is applicable:

> Organizations are created because people have bounded capacities for making decisions, and organizations allow specialization, decomposition, etc., which allow one to fit the work to the decision making capabilities of the people.

This implies that organizations stretch the decision making capacities of their people. Organizations stretch the capacities of their people through institutionalized decision making processes. These processes are logical relations of people that encourage the communication of relevant information in support of the decision (Baligh, 1986: 1481).

Communication has been likened to the cement that holds an organization together (Thayer, 1968: 48-51). This is accomplished through the transmission of information. In this role of support to the decision making process, information must be treated as a resource along with land, labor and capital. Information, then, as " ... a resource ... must be treated as such - a resource having costs and benefits associated with it" (Schoderbek, et al, 1985: 154). The use of information during a decision making process must then be guided by marginal analysis. Marginal analysis concludes that additional information will be acquired until the costs of the additional information exceed its benefits (Schoderbek, et al, 1985: 154-159).

During the Air Force process for enacting organizational resource allocation decisions, primarily in the major weapon system acquisition process, information is not specifically addressed as a resource. In decision theory, however, information is a valuable commodity as are the other traditional resources (personnel, equipment, raw materials, etc.). Therefore, when discussing acquisition decision making, information will be viewed as a scarce resource which should be used prudently. As the discussion develops in this chapter, the focus will be on the organization and the acquisition Program Manager, organizational processes for generation and communication of decision relevant information, and the Program Manager's role throughout that process.

The DOD Acquisition Process

In most discussions of the problems confronting the Air Force major weapon system acquisition process, there has been an inescapable tendency to focus on individual results. This was especially true of the media and to a lesser degree, the Congress. While understandable why the issue of a $9,600 allen wrench triggered a review of acquisition procedures, it is not a suitable example upon which to base findings and recommendations affecting the purchase of a new tactical fighter or the development of an advanced air-to-air radar. Secretary of Defense Casper Weinberger recently said that it is " ... alarming to see an issue as important as the proper level of American defense preparedness hanging on

questions such as whether departmental practices have resulted in overpayment for a hammer or an airplane toilet seat as if a system of zero errors were the goal ... " (Weinberger, 1986: 21).

More to the point, Hiatt and Atkinson believed that if everyone associated with the development and acquisition of major weapon systems was "... lost in the trees of program management, unable to see - far less influence - the policy forest ... " (Hiatt & Atkinson, 1985: 7), meaningful changes to overall conduct of the weapon system acquisition process would likely not occur. To successfully alter the direction of weapon system acquisitions required a systematic and comprehensive review of all elements associated with the process - particularly how decisions are made. A focus on micro-decisions (i.e. decisions made by an individual manager) within a single management process increases the risk associated with those decisions and to the meeting of the objectives of the weapon system acquisition process as a whole (Hiatt & Atkinson, 1985: 7).

These environmental forces influenced the nature of the overall acquisition task. The environment is defined as those factors outside the control of the organization but which materially affect how the organizations perform (Churchman, 1968: 36 and Schoderbek, et al 1985, 199-200). For this study, organizations outside the Department of the Air Force that materially affect the management of the development and acquisition of major weapon systems constitute the environment. To aid in this discussion, only two are addressed here: other Executive Branch agencies outside the Department of the Air Force and the United States Congress. After a review of the

structure and procedures of acquisition management, examples of recent environmental changes will be discussed in terms of their impact upon decisions made by the Program Manager during the weapon system acquisition processes.

The Structure of Acquisition Management. There is a long-standing tradition when discussing the weapon system acquisition system to immediately dissect the whole into easily managed parts (For example see Fox, 1974; Gansler, 1980 and DAF, 1976). More recently, Mullins stressed the importance of the interdependent nature of defense acquisition activities and their participants (1986: 113). While following the traditional approach on the surface, the key facet to be brought out of this study is the interdependence of the individual parts of the overall DOD acquisition system. Therefore, the decisions that occur during the product life-cycle of a major weapon system have been organized into four sub-processes (i.e. 'parts'): the requirements process, the budget process, the major weapon system acquisition process, and the contracting process. As pointed out by Mullins, each of these sub-processes is distinct but, at the same time, interdependent - a change to one often affects the others, sometimes in subtle, yet significant, ways.

The Operational Requirements Sub-Process. Through the operational requirements sub-process

> ... operational needs are formulated and related research, development, and acquisition (RD&A) programs are defined and undertaken. From these and succeeding programs, new and improved weapon systems emerge (DAF, 1985: 2).

Implicitly required during this sub-process is coordination throughout the Air Force that takes place prior to a requirement being 'validated'. A validated Statement of Operational Need (SON), the documented requirement, is an agreed to position by the corporate Air Force that an additional capability is required to facilitate the accomplishment of a stated Air Force mission. As stated in Air Force Regulation 57-1, Operational Needs:

> The SON has three principle uses: It defines an operational need, obtains official validation of the need, and furnishes preliminary guidance for RD&A planning by the responsible implementing and participating commands (DAF, 1985: 2).

Ideally, the military establishes missions based upon guidance provided from the civilian defense leadership which is headed by the President. This guidance takes the form of stated national objectives which require, to varying degrees, military support. Given these overall national objectives, and the accompanying military strategy deemed appropriate, the military then formulates a program to provide the armed forces necessary to accomplish the required tasks (Meehan, 1985).

The preparation of a SON is the first step in the long process of transforming a military requirement necessary to fulfill a national objective into a reality employable by the armed forces - in this case the Air Force. SON's may be initiated by any major command or higher headquarters in the Air Force. Usually they represent either an identified operational deficiency or a technological opportunity

(McCarty, 1986: 5). Opportunities arise from technological advances. Operational deficiencies come from one of three sources (DAF, 1985: 3).

1. Deficiencies caused by changes in the threat.

2. Deficiencies resulting from a redefinition of the assigned task.

3. Deficiencies stemming from a deterioration in operational performance (e.g. aging systems).

Perhaps the SON's most important function, however, is that it represents the first time in the acquisition life-cycle that a corporate Air Force decision is made concerning a possible new program. The coordination process required of a SON is lengthy and involves most segments within the Air Force. After a need is identified and documented in a prescribed format for the SON, the SON is submitted first to the other Major Commands for review and comment and then to the Air Staff. Air Force Systems Command (AFSC) and Air Force Logistics Command (AFLC) both comment from the perspective of developer and maintainer. Other operational commands comment on joint requirements or possible redundancies.

The Air Staff responds to the submission by selecting an Office of Primary Responsibility (OPR) and initiating the Air Staff coordination cycle. First, the SON is assessed to determine "... if the operational need is clear and satisfactorily substantiated and if the proposed program is sound and a suitable response to the need" (DAF, 1985: 13). This function is performed primarily by a General Officer panel called the Requirements Review Group (RRG). Validation of the SON by the RRG implies that "... the proposed program is

sound and can compete for funding in the POM process (DAF, 1985: 13). As the operational requirements sub-process proceeds into the budget sub-process, a Justification for Major System New Start (JMSNS) is required for a major system (A major system is one defined in accordance with criteria set forth in DODI 5000.2 - Major Systems Acquisition). The requirements sub-process is summarized in Figure 2.

The SON validation process is the Air Force method to ensure that new programs are truly needed and are the right programs before attempting to tackle the even more lengthy task of securing the needed resources to conduct the program. The requirements process is an organized set of micro-decisions aimed at determining whether a new program is appropriate to initiate. The primary communication channel is the coordination between major commands headquarters and the Air Staff coordination control by the RRG. There is no role for the Program Manager in the requirements process since the program has not yet begun, no manager has yet been appointed. AFSC's contribution is limited to providing information on technological considerations that may contribute to satisfying the need (DAF, 1985: 16).

The Budget Sub-Process. The 'budget process' not only involves accounting for funds but also is the systematic way in which the corporate Air Force makes resource allocation decisions. The system to accomplish the budget process is the Planning, Programming and Budgeting System (PPBS). The PPBS is "... the DOD resource management system ... [and] its purpose is to identify

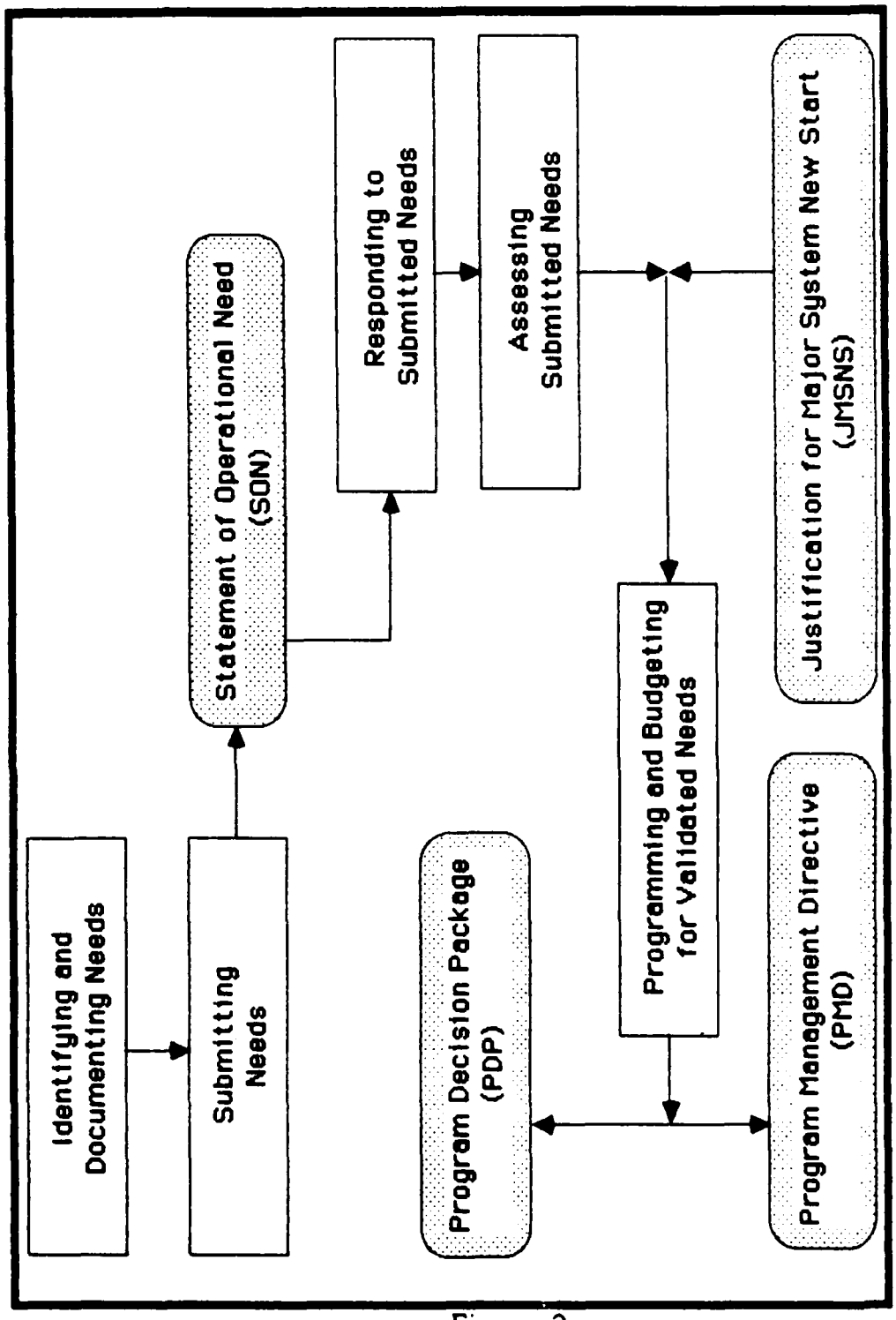

Figure 2

The Requirements Sub-Process

needs, match them with resource requirements, and translate them into budget proposals" (DAF, 1987: 2).

In general, "... planning refers to decisions by the organization about what results are desired and how the results should be accomplished (Anthony and Young, 1984: 4). Strategic planning deals with "... the futurity of current decisions" (Steiner, et al, 1982: 172).

Corporate planning in the business world:

> ... may be defined as a structure of plans. It is a structure that integrates strategic with short range operational plans. In this structure are integrated, at all levels, major objectives, strategies, policies, and functions of an enterprise (Steiner, et al, 1982: 173).

Programming decisions are those made "... with respect to the major programs the organization plans to undertake during the coming period" (Anthony & Young, 1984: 11). Programming is the bridge between the plans and their implementation.

Finally, "... a budget is a plan expressed in monetary terms" that identifies the organization element responsible for the task accomplishment (Anthony & Young, 1984: 357). Budgeting is an essential part of management control.

The PPBS is a dynamic and evolving system whose focus and procedures are sensitive to changes in key personnel and policy direction. "One of the greatest single sources of change is the seating of a new political administration. Each new Secretary of Defense adjusts the system to reflect his own style of management" (DAF, 1987: 2).

In the current administration, for example, one of the areas of emphasis relevant to the decision making process is 'participatory management'. This concept deals with the decision making process by defining who the players are. Recently, the role of the operational Commanders in Chief (CinC) and the Joint Chiefs of Staff (JCS) has been strengthened (Carlucci, 1981: 3).

As the name implies, there are three phases in the PPBS: planning, programming and budgeting (DAF, 1987: 8). The DOD planning phase complements the requirements validation process outlined above. It is designed to document the forces required to counter the currently defined threat within the constraints of the Air Force mission statement. The planning phase is the benchmark that highlights critical needs and examines risks. It differs from the requirements process in that it deals with all needs, not just newly defined requirements.

The key document produced during the planning phase of the PPBS is the Defense Guidance (DG). The DG

> ... is designed to guide resource allocation decisions which occur during the programming and budgeting phases. Services develop their program proposals in accordance with it while OSD and Joint Staff use it as the baseline for program review (DAF, 1987: 14)

As the Secretary of Defense guidance to all DOD, the DG addresses policy guidance, strategy, force planning, resource planning, fiscal guidance and major issues. Although the DG is primarily the SECDEF's direction to the DOD, all elements within the Defense Department have the opportunity to input to it. "The Air Force has

two channels for input [to the DG] - first directly to OSD and second through the JCS. Air Force Major Commands... provide their input to [the Air Staff]; Specified Commands through the JCS as well "(DAF, 1987: 14).

In terms of Air Force decision making, the DOD programming phase is probably the most critical. Programming in the Air Force is accomplished through the Program Objective Memorandum (POM). The POM is the document which is developed and coordinated throughout the Air Force to match available funding with the most critical identified needs. The key product of this phase is the 5-year defense resource proposal (Five Year Defense Program - FYDP) which becomes the foundation for the Air Force budget submission to DOD (DAF, 1987: 9). The FYDP documents the SECDEF approved programs for the DOD. It is a detailed and integrated summary of resources: forces, costs, manpower, procurement and construction (DAF, 1987: 5).

It is during the POM coordination process that many, if not all, key resource allocation decisions are made.

> The programming segment is the first point in the PPBS process where fiscal constraints are matched against resource requirements and it is likely to impact alternatives selected during the planning segments (DAF, 1987: 17)

A critically important feature of the programming phase of the PPBS is the coordination that is accomplished. The POM is a corporate Air Force program proposal and is based upon the DG (DAF, 1987: 17). The coordination of the Air Force program proposal during the POM deliberations at the Air Staff are the final adjustment to

program funding levels prior to submission to OSD. The Air Staff coordination process is accomplished through the Air Force Board structure. "A key feature of the AF POM development process is the use of a corporate review body - the Air Force Board Structure" (DAF, 1987: 18). The Board Structure 'brings together' all aspects of the Air Force POM development process, provides for 'openness' during the POM development process, and provides recommendations to the Chief of Staff of the Air Force and to the Secretary of the Air Force (DAF, 1987: 18).

The actions taken during POM development become key determinants of the life or death of programs. No matter how well stated a requirement may be, or how attractive a technological opportunity is, without funding support in the POM, that program will not succeed. Within the acquisition community, funding in the POM is recognized as a key and continuing milestone for a PM to negotiate during a program's life (ACSC, 1981: 27).

The POM is submitted first to the DOD, then to the Office of Management and Budget (OMB), and ultimately to the Congress as part of the President's budget proposal. The budgeting phase of the PPBS involves the execution of Congressional authorization and appropriation legislation. The budget is the "... planned program for a fiscal period in terms of estimated costs, obligations, and expenditures" (DAF, 1987: 47). The budget is the foundation upon which the resource management control systems of the Air Force are based. Resource management information focuses upon outputs and resources used, the managers responsible for mission accomplishment,

actual performance in relation to planned performance (i.e. budgeted requirements), expense operating budgets and accounting systems to enhance management control, and working capital techniques to assist in accounting for inventory (AFIT, 1987: 76).

The role of the Program Manager in the budget sub-process is considerable. The POM is 'built from the bottom up' (DAF, 1987: 25). Individual programs are documented in Program Decision Packages (PDP) and assigned a single Program Element Monitor (PEM) who is the Air Staff OPR for that program (DAF, 1987: 23). The PEM, however, gets the necessary information from the field. In the acquisition arena this means the PM. The PM is responsible for "... acquiring and fielding a system that meets the approved mission need and achieves established cost, schedule, readiness, and *affordability objectives* (DOD, 1986: 13). Under the tenants of participatory management and the bottoms up approach to building the Air Force POM, the PM is specifically responsible for making "... timely planning and programming inputs... to identify funding requirements for the acquisition program (DAF, 1986: 6). The budget sub-process is summarized in Figure 3.

The Acquisition Management Sub-Process. The DOD directive that guides weapon system acquisition activities, Department of Defense Directive 5000.1 - Major System Acquisitions, states that it "... is the policy of the Department of Defense to ensure that DOD acquisition of major defense systems is carried out efficiently and effectively to achieve the operational objectives of the

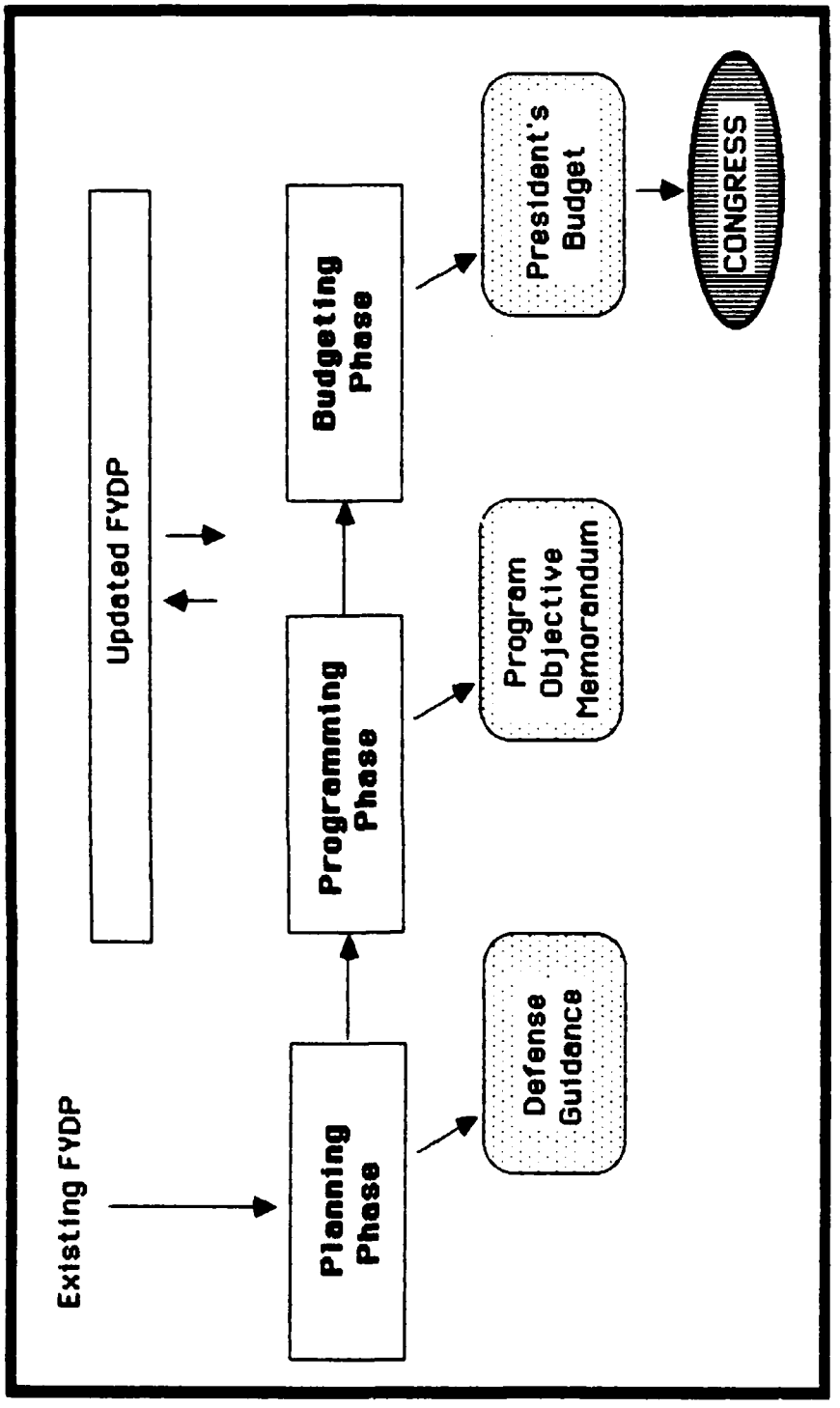

Figure 3

The Budget Sub-Process

U.S. Armed Forces in their support of national policies and objectives" (DOD, 1986:1).

The process is structured to accomplish those goals by having each program progress through a series of four key decision points, or milestones, at which specific items are addressed. The key decisions that are made at these milestones are primarily retained " ... at the level of agency head" (OMB, 1976: 6-7). In the DOD, this is the Secretary of Defense (SECDEF). As a program passes each milestone, programmatic and technical risks are judged to have been reduced sufficiently to warrant the commitment of additional resources toward the completion of the program. The resources concerned are primarily funding and manpower although a strong case could be made that, implicitly, time is also very important.

The four key milestones are defined below (DOD, 1986: 12-13). As shown in Figure 4, each decision results in incrementally more resources committed to the program in response to decreasing program risk.

> Milestone 0, Mission Need Determination, complements the requirements and budget processes discussed above. At this milestone, a validated requirement is combined with POM support resulting in program initiation. The program effort immediately after this decision addresses conceptual investigation of alternative methods to meet the operational need identified in the SON.

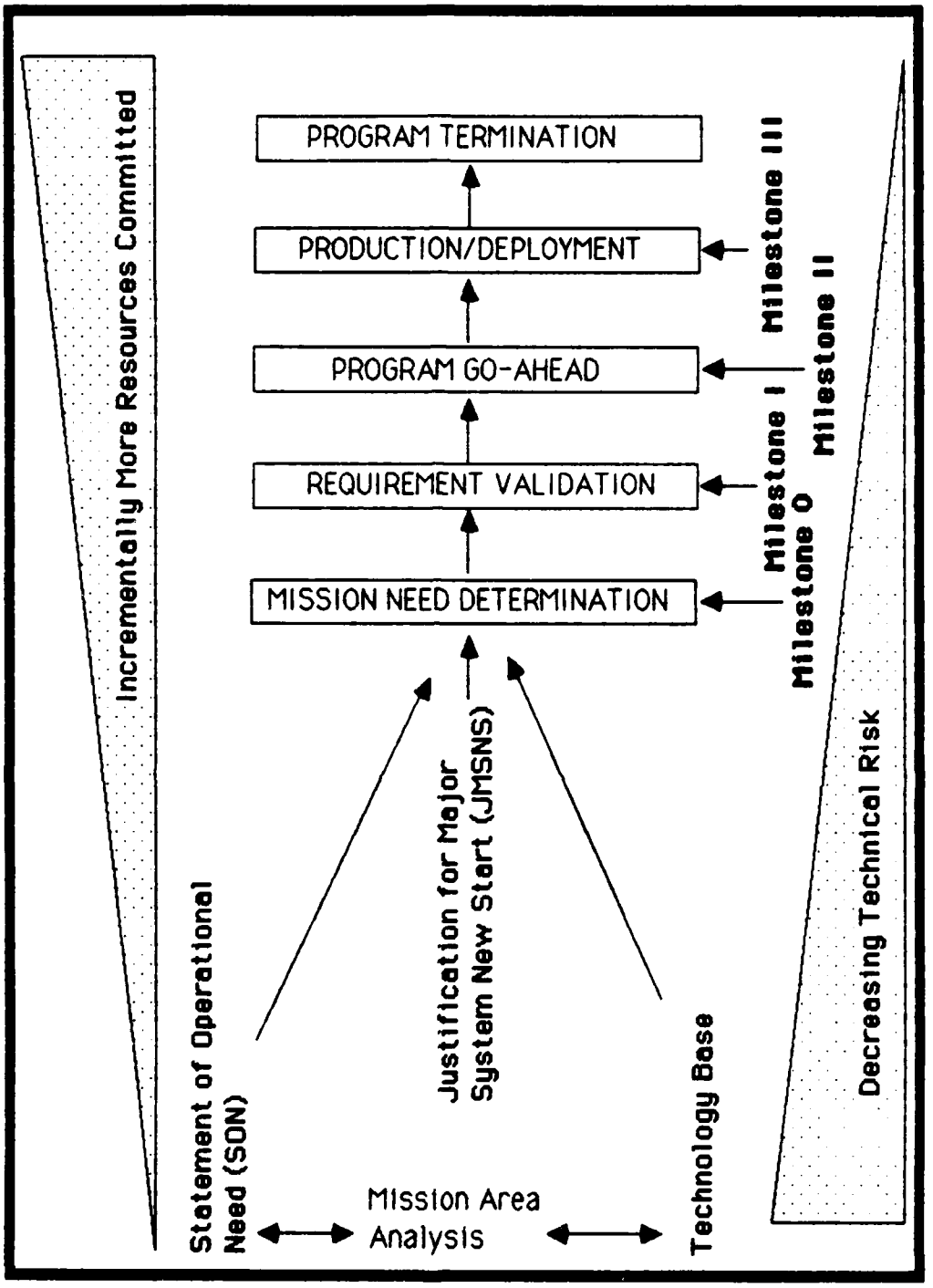

Figure 4

The Acquisition Management Sub-Process

> Milestone I, Requirement Validation, takes the results of the conceptual studies and determines the best direction in which to proceed. For major programs, this decision is made by the Secretary of Defense (SECDEF) after review of the program by the Defense System Acquisition Review Council (DSARC). After the Milestone I decision, the program begins the demonstration and validation phase. It is during this phase that the Air Force has the first opportunity to test methods of satisfying the operational need that originally triggered the program.
>
> At Milestone II, Program Go-Ahead, the DSARC again reviews the program for adequate progress. If the operational need is still current and if the risks continue to be acceptable, the program is approved for Full-Scale Development go-ahead. This decision, however, is constrained to a specific level by the funding that has been made available by the budget process.
>
> The decision to proceed into production is made at Milestone III, Production/Deployment Go-Ahead. Instead of a DSARC review, the authority for this decision has been delegated to the Secretary of the Air Force (SAF). The SAF is supported by the Air Force System Acquisition Review Council (AFSARC) - a body analogous to the DSARC but at the DAF level (DOD, 1986: 12-13).

The role of the PM is most visible in the acquisition management process. "The Program Manager is the program's chief executive, chief diplomat, chief doctor, and chief 'flak-taker' all rolled into one person... [and] In accordance with the Air Force's single manager concept... is... assigned ultimate program management responsibility" (ACSC, 1981: 38). The specific responsibilities assigned to the PM include (DAF, 1986: 6):

- managing the assigned acquisition program using the assistance, advice and recommendations of participating commands;

- making management decisions within the approved program (i.e. as documented in the Program Management Directive) after equally weighing cost, schedule, performance, supportability, training requirements, and reliability and maintainability;

- preparing a program baseline to assess and to document how the program is to progress;

- ensuring that all program documentation receive adequate communication and coordination with all program participants;

- assessing the program's progress against its objectives, constraints and thresholds; and

- making timely planning and programming inputs.

To summarize, the acquisition management sub-process is a sequence of decisions that determine whether a stated need and a program's progress warrant its attendant costs and risks. The PM, as the single manager responsible for all technical and business decisions (ACSC, 1981: 39), is the key link in the Air Force's acquisition decision making chain.

The Contracting Sub-Process. The progress of a program from one milestone to the next depends not only on success in the budget sub-process (i.e. funding provided) but also on the ability of the program management staff to accomplish the technical development and production efforts required. The four phase

contracting sub-process is the system that guides the technical conduct of a program (Westfall, 1987: 160).

The contracting sub-process can occur many times during the life of a single weapon system acquisition. The first contracting phase is Requirements Definition. Based upon the results of decisions in other processes (the requirements sub-process, the budget sub-process, or the acquisition management sub-process), the tasks required to be accomplished by a contractor in support of the program's approved objectives are laid out for inclusion in a Request for Proposal (RFP). The RFP is the document that contractors base their proposals on, both in terms of their technical approach and price. The contract will request effort consistent with the validated SON, at a level within the established funding constraints in the approved POM and provided in the budget, and at a time consistent with the goals of the overall weapon system acquisition life-cycle (Westfall, 1987: 163-164).

The second phase is Procurement Planning. It is this time when decisions are made concerning the type of contract anticipated (e.g. fixed price, etc.) and possible sources to be solicited. The latter is particularly important today because this implies the degree of competition possible.

After contractor proposals are received by the program managers, the program managers evaluate the proposals to determine who the ultimate winner will be. This phase is called Offer Evaluation. Within this phase is yet another process, the Source Selection Process, which controls the evaluation of the

contractor proposals. Each proposal is evaluated against specific and uniform assessment criteria. These assessment criteria can include soundness of approach, understanding the requirements, compliance with requirements, past performance, and other evaluation criteria (e.g. cost) (DAF, 1984: 8, 19).

In major weapon system acquisitions cost does not constitute the only discriminating factor. Given the complexity of modern weapon systems, and the unknowns involved in their development, the technical and managerial criteria carry equal weight with price. It would not be desirable to award a contract to the lowest bidder only to find that the firm is unable to perform satisfactorily. The dollar sums involved are simply too great (Westfall, 1987: 164-165).

The Contract Management phase follows the award of the contract and lasts until the contract is completed. This may not coincide with completion of the entire program. Again, many contracts can make up any given acquisition program. The completion of one is often just the beginning of another. During the Contract Management phase the contractor is monitored to ensure that the terms of the contract are complied with and that necessary changes are implemented (Westfall, 1987: 165-166). The contracting sub-process is summarized in Figure 5.

Fox points out that in the contracting process the roles of the PM and the Procurement Contracting Officer (PCO) sometimes overlap. The tasks normally within the province of the PCO include (Fox, 1974: 174):

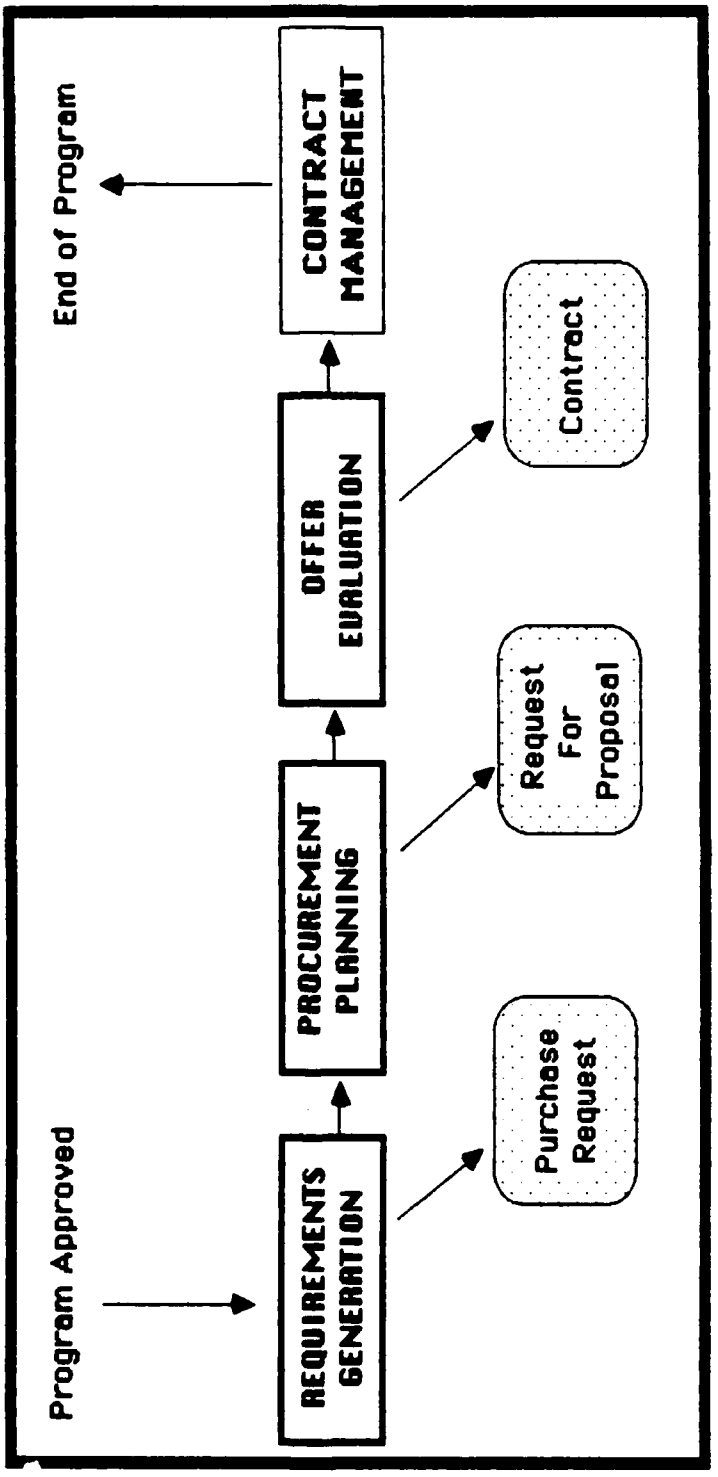

Figure 5

The Contracting Sub-Process

- administration of contracts, under the supervision of the PM;

- approval of subcontract terms, conditions, and costs;

- preparation of field analyses of contract-change proposals and their impact on costs, schedules, and technical performance; and

- miscellaneous duties, including interpretation of contract provisions, review and analysis of reports, progress surveillance, and across the board support for the PM.

The Program Manager's prerogatives during the contracting process include (Fox, 1974: 175):

- overall technical control, including responsibility for decisions affecting design, reliability, and trade-offs in design because of cost and schedule considerations;

- approval of specifications;

- approval of plans to subcontract;

- technical guidance in the selection of subcontractors; and

- approval of contract-change proposals involving design modifications, additional costs, and changes in schedule.

Although only the PCO retains the authority to obligate the government contractually, the role of the PM is still significant in terms of overall decision making duties and responsibilities and the requirements for information generation and communication. As illustrated in Figure 6, there is a track of documentation through the overall weapon system acquisition system. This track of program

documents overlaps the four sub-processes discussed above. The PM is the link between the sub-processes and the management continuity from the early phases of the program through the final termination of the contractual effort.

The key documents that provide this track are the Statement of Operational Need (SON), the Program Objective Memorandum (POM), the Program Management Directive (PMD), the Request for Proposal RFP) and the contract. The SON provides the organizational requirement, the POM is an organizational statement of prioritized program funding, the PMD is is organizational direction to an action officer to initiate program effort, and the RFP and contract are the organization's interface with industry.

Recent Environmental Changes. The preceding was a necessarily brief review of the major components of the weapon system acquisition process. The review focussed on the complexities of decision making during major weapon system acquisitions, the documentation produced and the role of the program manager in the sub-processes. The degree of overlap between the different sub-processes and their inherent structural relationships are considerable. What is apparent is that decision making within the Air Force acquisition community is interwoven to a considerable extent and that a change in one sub-process, at any organizational level, can possibly have significant and unforeseen ramifications in others.

To illustrate these possibilities, four specific changes in the Air Force acquisition environment will be discussed. The intent is to show that while the specific objectives of each of these changes can

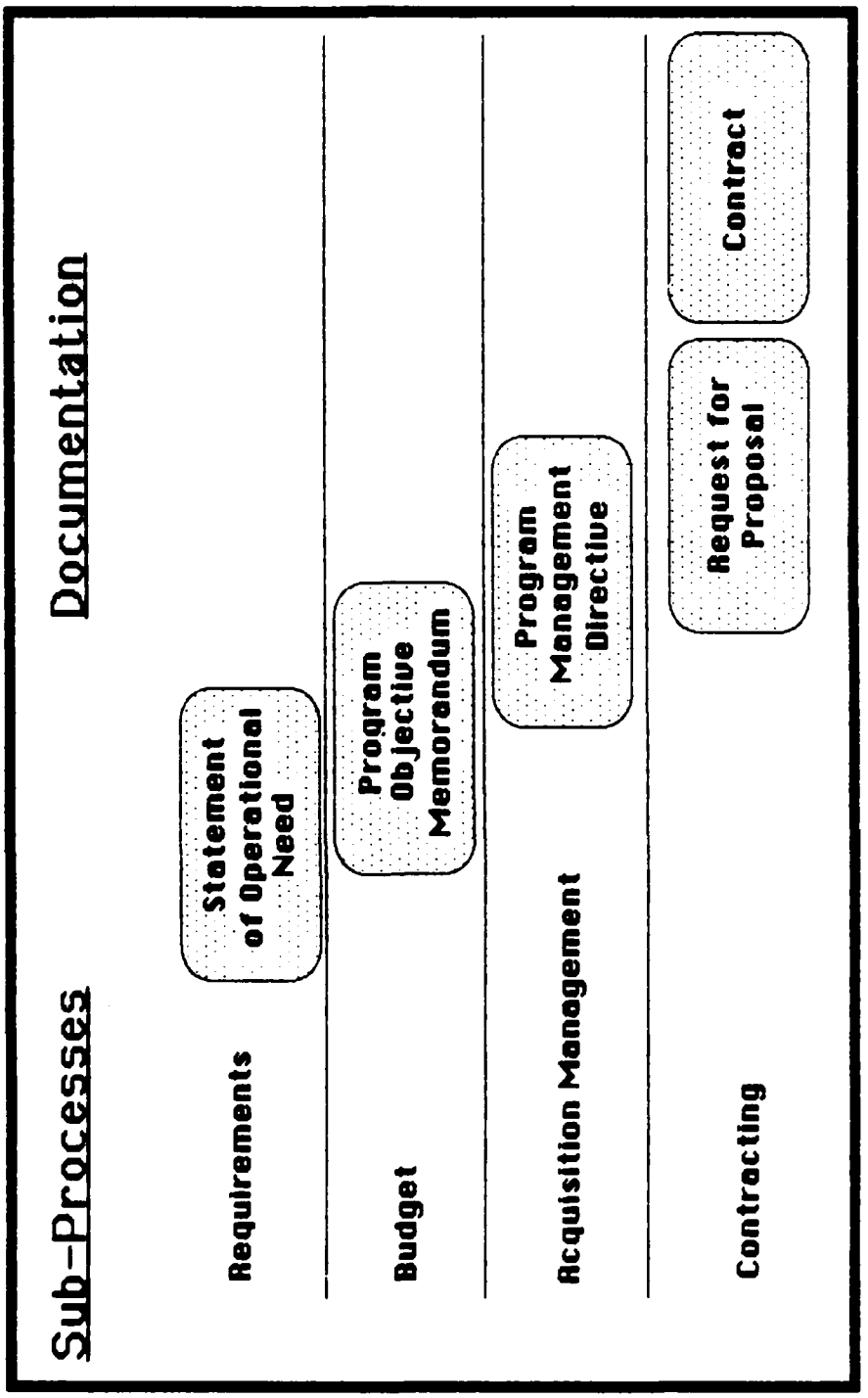

Figure 6

Sub-Process Integration

be concisely stated, the side-effects which they promulgate might not be readily apparent. As before, the focus of the discussion will be the acquisition decision making role of the PM.

The changes to be discussed, and the processes they impact, based on the discussion above, are shown below in Figure 7. The relative impacts on the sub-processes for each of the environmental influences were subjectively estimated by the author based upon the references cited.

	Balanced Budget and Emergency Deficit Control Act	Competition in Contracting Act	Department of Defense Reorganization Act	Packard Commission
Requirements	S		P	P
Budget	P		S	P
Acquisition Management	S	S	S	P
Contracting		P		P
		P - Primary Intent	S - Secondary Effects	

Figure 7

Environmental Changes & Impacts

Three of the changes are legislation passed by the Congress and signed into law by the President. The last is the result of a Presidential Blue Ribbon Panel. The acquisition management process primarily intended to be influenced by the change is identified as primary while others affected are identified as secondary.

Balanced Budget and Emergency Deficit Control Act. The Graham-Rudman-Hollings legislation is perhaps the most controversial in recent years. Officially titled the Balanced Budget and Emergency Deficit Control Act (P.L. 99-177), it is intended to remedy problems in the Congressional budget process as defined in the existing law, the Congressional Budget and Impoundment Control Act of 1974 (P.L. 93-344).

Although the budget formulation procedures enacted in Graham-Rudman-Hollings are very similar to those in effect since 1974, there are changes. The two most significant changes are

> the setting of specific deficit targets - 'maximum deficit amounts' - for fiscal years 1986 through 1991 which the President and Congress must follow, and a new enforcement mechanism - 'sequestration' - that automatically cuts federal spending by whatever amount is needed to reach the deficit target for the coming year when the President and Congress are unable or unwilling to agree on a deficit reduction plan of their own" (Collender, 1986: 15).

While the setting of maximum deficit amounts is perhaps admirable and even necessary, it is the provision for sequestration and what it entails with respect to decision making that is of interest here. Secretary of Defense Weinberger has likened sequestration to an indiscriminate club that Congress will swing to cut the budget (Weinberger, 1986: 21). Sequestration is a process that will occur automatically without further Congressional debate or Presidential discretionary action. The law prescribes what will happen and when.

At the end of last fiscal year (FY 86) the sequestration process was invoked. Although this specific procedure within Graham-Rudman-Hollings has been challenged and found unconstitutional on the grounds that it is an unconstitutional delegation of authority to the Comptroller General (a part of the Executive Branch), it was exercised in 1986.

It is the fact that sequestration is an 'indiscriminate club' which requires its discussion here in the context of acquisition PM decision making. The law provides that all eligible programs, defense and non-defense, must equally share the burden of the budget reductions required to meet the maximum allowable deficits as written in the legislation. By definition, the process does not allow consideration of priorities among competing programs. Regardless of the apparent irrationality of a cut to a particular program's budget, either in economic terms or its possible effect on national security, without decisive action on the part of the Congress and the President, the cut will take place.

Consider a program such as the available inventory of munitions, whose health is critical to the nation's warfighting ability. "The progress achieved [in recent years] in the inventory levels of our munitions is truly a success story. But, these are the very types of successes that will be the first to turn into shortages under successive Graham-Rudman sequestrations, since there is no possibility, under the law, of choosing priorities" (Weinberger, 1986: 19).

This perturbation to the setting of priorities, and subsequent acting in accordance with those priorities, is the critical effect of the Balanced Budget and Emergency Deficit Control Act upon Air Force acquisition program management decision making. Its effects can trigger repercussions through the budget process as the Air Force attempts to adjust to the reductions mandated in the law. Although the budget process will be the primary location of this activity, other processes will be effected too.

Since the ability to act effectively upon established priorities will be reduced or completely removed, the process of determining requirements must now take that possibility into account. There is already a tendency to propose 'requirements' only if strong 'budget' support is considered likely. Requirements might be withheld prematurely because of perceived budget risk before they had a sufficient review in the SON validation cycle. Operational requirement determination could become a follow-on to the budget process instead of the reverse (Meehan, 1985: 29-39).

Even after a program has been initiated, the effects of Graham-Rudman will still be felt. A program in the production phase, for example, could have its budget cut, requiring among other things, a reduction in yearly buy quantities. The mistaken opinion of some is that this results in cost savings where, in fact, the opposite is true. The contract change required to adjust the quantity will cost the Air Force program extra funds in the year it is enacted and the unit price of the items being purchased will also rise (Gansler, 1980: 220-224).

The Competition in Contracting Act. The Competition in Contracting Act was passed by Congress and signed into law by the President in 1985. The act embodies the prevailing mood in the Congress that competition in government contracting will result in lower prices and less corruption. This may not be so. Some are concerned that "... competition is not axiomatic with reduced program cost" (Grosen and Augusta, 1986: 33). Issues such as dual sourcing and effects on learning curves, unit prices and total program costs have yet to be fully addressed (Grosen and Augusta, 1986: 36).

These concerns are not the primary issue here, however. For whether there are cost savings to be reaped from competition or not, the new emphasis on competition is already affecting the Air Force contracting process.

In the procurement planning phase of the contracting process, competition is now the key goal when laying out the procurement plan. Air Force contracting personnel and program managers must take all measures possible to achieve 'full and open competition'. Anything less must be either explained and/or justified.

This requirement impacts the acquisition management sub-process as well. A program manager must be careful how the contracts are arranged in terms of budgetary timing and the technical phase of the program. A contractor whose contract expires may not be able to simply renegotiate and continue. The balance of the effort might be competed and the contract awarded to another firm.

Although this sounds good on the surface, from a program cost view point, the new potentially less expensive contractor must now be brought 'up-to-speed'. There will be inevitable miscommunications and false starts. These costs, however, are very difficult to document.

Department of Defense Reorganization Act. There has been concern for some time about the Pentagon's ability to plan. As early as 1979, studies on the organization of the DOD "... either explicitly or implicitly addressed the capability of the Department of Defense to plan" (Barrett, 1981: 112).

On 1 October 1986, the President signed the Goldwater-Nichols Department of Defense Reorganization Act. The act goes beyond simply reforming the JCS and instead attempts to improve multi-service planning, coordination and warfighting. More power will be given to the Commanders in Chief of the Unified and Specified Commands. This includes not only operational authority, but also a greater say in programming decisions.

The JCS staff will be strengthened as will the Chairman of the Joint Chiefs. These actions are intended to improve planning at the joint level and provide better 'military advice' from the top military spokesman - the Chairman of the JCS.

The military departments (Air Force, Army and Navy) are also reorganized. Specifically,

> ... the sole responsibility for acquisition, auditing, comptroller functions, information management, inspector general duties, legislative affairs, and public affairs will be consolidated in each Service secretariat. The military

> headquarters staffs are barred from establishing or designating any office within their headquarters to conduct any of those functions (Ganley, 1986: 25)

Although the primary focus of these three actions is on the planning function, there will undoubtedly be significant impacts on both the budgeting process and the acquisition management sub-process. The PPBS will likely see a shift in power toward field commanders. Whether or not this will affect decision making process results is unknown, but it will probably result in qualitatively different programming decisions (Ganley, 1986: 24).

With a single Air Force acquisition staff in the Pentagon now, the level of review that programs receive will change. An intent was to reduce the levels of bureaucracy that a program manager had to go through in order to gain approval for a decision. As above, whether or not that will actually be the case remains to be seen (Ganley, 1986: 25).

The Packard Commission Report. The President's Blue Ribbon Commission on Defense Management (the Packard Commission) submitted its report to the President and the Secretary of Defense on 30 June 1986. It contained recommendations for improving the management of the DOD in four areas: National Security Planning and Budgeting, Military Organization and Control, Acquisition Organization and Procedures, and Government-Industry Accountability.

Many of the recommendations presented in the report are being implemented. For example, the Goldwater-Nichols Act of 1986 enacted most of the Commission's Military Organization and

Command recommendations. Specifically, the role of the JCS in both planning and force employment was strengthened.

The importance of the report to this discussion is that it demonstrates that a systematic and comprehensive and integrated review of decision making elements can be accomplished. This study shares that goal. As shown in Figure 7, the Commission's recommendations touched all four of the weapon system acquisition decision making sub-processes discussed earlier in this section.

Without Congressional action, however, many of the more significant recommendations can not be implemented. Deputy Secretary of Defense Taft stated clearly that

> If the commission's recommendations are to be fully realized, the Congress must make changes, not by enacting legislation aimed at the executive branch but by altering the way it conducts its responsibilities for national security. Among changes needed are: reduction of the line item decision-making by Congress; adoption of biennial budgets; and limitation of defense oversight to the committees properly charged with that responsibility (Taft, 1986: 23).

There are many decisions made within the Air Force, DOD, and Congress, during the acquisition of a new weapon system. As discussed above, these decisions are interrelated through a network of four basic sub-processes. Changes aimed at any one managerial level decision may cause unforeseen changes or complications in another managerial level decision.

The acquisition Program Manager is the constant organizational focal point throughout the four sub-processes. It is also the PM that is the focus of organizational actions taken in response to the four

recent environmental changes discussed. The ability of the PM to respond to environmental influences while at the same time working within four distinct acquisition system sub-process is key to the efficient and effective conduct of the program.

Management Theory

Management has been defined as a process undertaken by individuals to coordinate the work of others to achieve results that would not have been achieved by any of the individuals acting alone. Managers are the individuals responsible for achieving these results through the specialized efforts of others (Donnelly, et al, 1984: 3).

Management can be further defined in terms of the functions the manager is responsible for accomplishing. The five functions originally described by Henri Fayol in 1916 are still used today. The functions of management are planning, organizing, coordinating, commanding (or directing), and controlling. The focus of the Fayol school of management represented a shift from the workshop orientation of Frederick Taylor to an entire organization perspective (Hellriegel & Slocum, 1974: 58-59).

Organizational Structure. As discussed above, the structure of Air Force acquisition decision making is complex organizationally. Complex organizational structures come in several types, from the theories of Classical management to the behaviorists (Miner, 1982, viii). The theory of bureaucracy, general systems theory and socio-

technical systems theory though are of primary interest to this discussion.

The bureaucratic model is the oldest and most prevalent model of management. Though not a monolithic concept, the following characteristics, while varying in degree from application to application, capture 'the essence' of the bureaucratic model of organization (Harrison, 1978: 205-210).

- a division of labor based on functional specialization,
- a well-defined hierarchy of authority,
- a system of rules covering the rights and duties of positional incumbents,
- a system of procedures for dealing with work situations,
- impersonality of interpersonal relations, and
- promotion and selection for employment on the basis of technical competence (Harrison, 1978: 207).

The chief advantage of the bureaucratic model is its technical efficiency which emphasizes precision, speed, expert control, continuity, discretion and optimal returns on investment (Harrison, 1978: 210). Disadvantages discussed in the literature include: adverse impacts on motivation, a tendency toward goal-displacement and self-service, the creation of elitism, and a loss of control over the operations of the organization (Harrison, 1978: 211-212).

The systems model is a

> ... **holistic** concept in that it views the organization as a totality composed of interrelated processes and functions.

> functions. It is also a **global** concept in that it views the organization as operating in a larger environmental universe. Finally, it is a **synergistic** concept in that it assumes the optimal integration of the elements that comprise the system (Harrison, 1978: 267). [Emphasis in original]

Systems theory is based to a large extent on the work of von Bertalanffy and Boulding and their efforts to define a General Systems Theory that would apply to any discipline. In this regard General Systems Theory is the "conceptual underpinning" of the systems model (Harrison, 1978: 271). Systems theory has been applied to several activities within organizations: the total process of management, managerial decision making, and information processing (Harrison, 1978: 268). The following is offered as a comprehensive definition of a management system.

> A management system can be defined as that subsystem of the organization whose components consist of a subset of individuals (man to man) whose duties are to receive certain organizational problems (**inputs**) and thereupon to execute a set of activities (**process**) which will produce organizational solutions (**outputs**) for either increasing the value or return of the total organizational activity (satisficing) or for optimizing some function of the total organizational inputs and outputs (Young, 1966: 15) [Emphasis added]

Management systems can also be defined as "... a number of components or subsystems that can be related to a plan setting forth the objectives of the organization (Harrison, 1978: 270). Relating back to an overall definition of management, systems theory states that:

> Managers are needed to convert the disorganized resources of men, machines, and money into a useful and effective enterprise. Essentially, management is the

process whereby these unrelated resources are integrated into a total system for objective accomplishment (Johnson, et al, 1973: 15).

In discussions of systems theory, the concepts of closed and open systems must be introduced. A closed system is essentially self-contained, with all its resources present within it. A closed system neither impacts its environment nor is impacted by its environment. Open systems, however,

> ...import resources from the environment, transform them into some useful output, and export the output into the environment. This input-transformation [process]-output cycle undergoes continuous iteration (Schoderbek, et al, 1985: 45) [...] added

Figure 8 summarizes the systems theory of management.

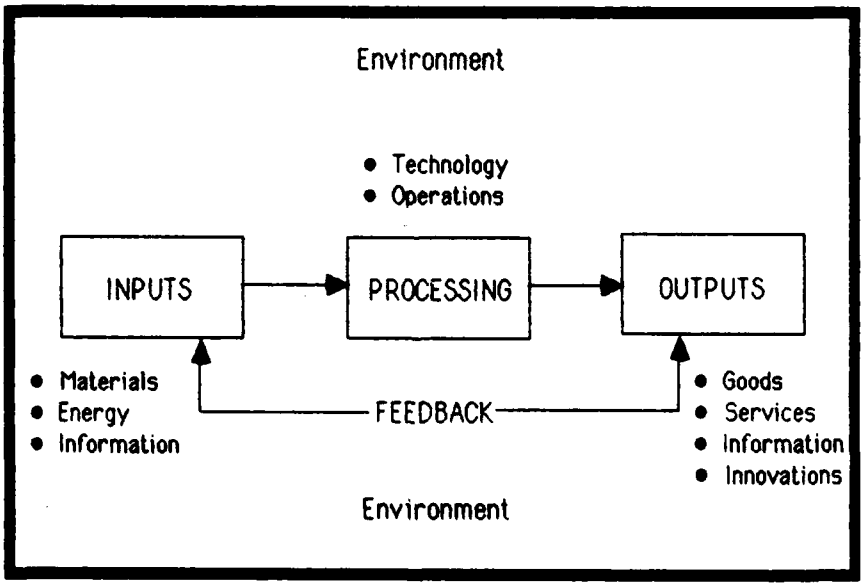

Figure 8

The Open System Model

Within an organizational construct defined as an open system, Emery and Trist described sociotechnical systems as "... the technological component in converting inputs into outputs" (Harrison, 1978: 327). As such, the sociotechnical systems functions as a boundary spanner between the organization, its members, and its environment (Harrison, 1978: 328). This relationship is summarized in Figure 9.

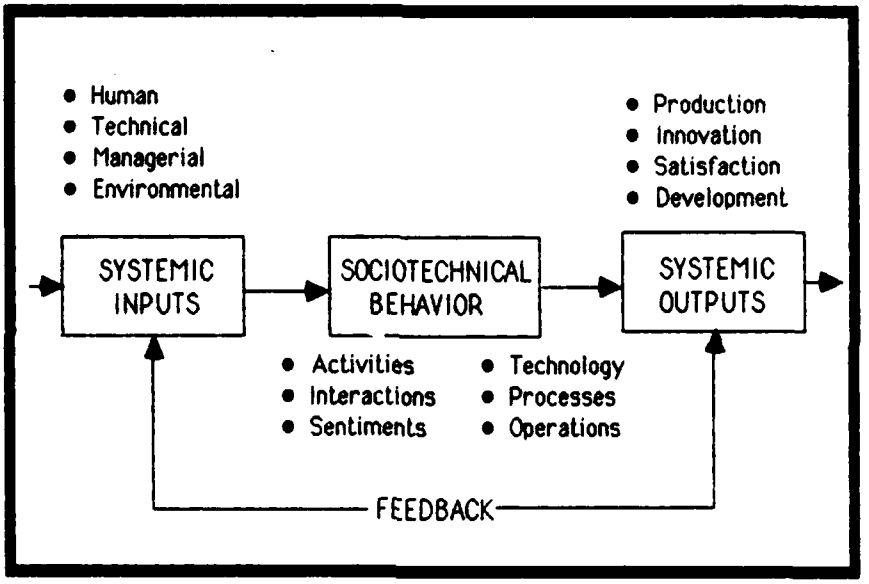

Figure 9

The Socio-Technical System Model

The following are definitions (Harrison, 1978: 328-329) applicable to Figure 9:

Systemic Inputs -

- *Human inputs* including personality, skills, values, intelligence, expectations and needs;

- *Technical inputs* including techniques, knowledge, information, materials, and facilitating services;

- *Managerial inputs* including objectives, plans, decisions, authority, communication, and controls; and

- *Environmental inputs* including societal, political, ecological, cultural, legal, and religious.

Sociotechnical Behavior (Social elements) -

- *Activities* or the things people do, such as walking, talking, sitting, working, and thinking;

- *Interactions* or actions in relation to other people, such as helping, sharing, and meeting; and

- *Sentiments* or the feelings people develop about what they are doing, what is being done to them, and the people with whom they are associated.

Sociotechnical Behavior (Technical elements) -

- *Technology* which is the current level of knowledge or the state-of-the-art with regard to the processes and operations required to transform systemic inputs into systemic outputs;

- *Processes* which include the various sequences or groups of operations required to apply the technology in the various stages of the total transformation process; and

- *Operations* which entail particular acts or applications of the individual processes through which the systemic inputs are progressively transformed by stages into systemic outputs.

Systemic Outputs -

- *Production* which is a tangible measure of organizational accomplishment relative to the resources committed to obtaining it;

- *Innovation* which is technological change involving new products or new uses for existing products;

- *Satisfaction* which is a measure of fulfillment of human needs; and

- *Development* which is a measure of the organization as a more viable entity or the individual as a more accomplished performer.

Within sociotechnical theory, technology is defined as the systematic application of organized knowledge to practical tasks. Technology is "... inextricably interrelated with the other systems that make up the total organization ... and it "... exerts a substantial influence on the formal organization structure, the system of management, and the social system of a given formal organization" (Harrison, 1978: 338).

Systems can be divided and sub-divided into subsystems and subsubsystems. This process is called 'nesting' (Schoderbek, et al, 1985: 51). Several propositions apply to the nesting of systems.

1. A system is always made up of other systems.

2. Given a system, another can always be found that comprises it.

3. Given two systems, the one comprising the other can be called a higher level system and the system comprised by the higher level system can be called the lower level system.

4. A hierarchy of systems exists whereby lower level systems are part of higher level systems.

5. The lower level systems are in turn made up of other systems and can be considered the higher level system for the lower level systems to be found in it (Van Gigch, 1974: 44).

The preceding discussion of organizational structure illustrates the basic theoretical foundations available for the development of an normative organizational decision making framework. The organizational situation faced by the acquisition Program Manager is approximated by the bureaucratic model. This is true particularly with respect to the authority hierarchy and the formalization of procedures.

To make this approximation closer to the total reality faced by the acquisition Program Manager, however, the open systems theory model and the socio-technical model were introduced. The open systems theory model provides for a way of effectively characterizing the flow of management through a three step paradigm: inputs, processes, and outputs. Such a perspective is valuable for the PM and the tasks of relating the four different sub-processes to the overall objectives of the program.

The socio-technical model provides additional richness in that it expands the definitions of the inputs and outputs while focusing upon processes as being comprised of many facets, both formal and informal. In the leadership and communication roles, the ability of the PM to consider to entire systemic situation increases the likelihood of effective management action.

Organizational Effectiveness. Managers, however, cannot discharge their functional responsibilities without using other important skills. The ability to make effective decisions is one of these skills. Peter F. Drucker stated that only managers, and high level executives in particular, make decisions. They may do other things as well, but the "... first managerial skill is ... the making of effective decisions" (Drucker, 1974: 465).

Drucker defines a decision as a choice between alternatives. He goes on to define an effective decision as one that includes a commitment of action and results (Drucker, 1974: 476). A still more rigorous definition is proposed by Ronald A. Howard. Howard and Matheson define a decision as

> ... an irrevocable allocation of resources, in the sense that it would take additional resources, perhaps prohibitive in amount, to change the allocation... (Matheson & Howard, 1983: 23).

Ebert and Mitchell reviewed the definitions of decisions and decision making in several disciplines. They explored both choice behavior and problem solving behavior dimensions and arrived at an integrated definition. They defined organizational decision making as

> ... the choice processes that occur in the organizational setting together with the choice related behaviors and the processes producing them that are directed towards the resolution of organizational problems to reach organizational goals (Ebert & Mitchell, 1975: 12).

The Ebert and Mitchell definition emphasizes the organization. This is a critical factor since managers do not make effective decisions in a vacuum. As Drucker pointed out, an effective decision requires

a commitment to action. Since managers evoke action from other people, the ability of the manager to make decisions within the context of an organization is the key to effectiveness.

Managerial effectiveness is defined in terms of resource utilization in relation to organizational goal attainment. On the other hand, managerial efficiency is defined in terms of the proportion of total organization resources that contribute to productivity during the transformation process. (Certo, 1983: 12-13). Anthony defines efficiency as simply the ratio of outputs to inputs and effectiveness as the relationship between a responsibility center's output and its objectives (Anthony & Young, 1984: 18-19) In terms of systems theory, efficiency deals with the ratio of inputs to outputs while effectiveness deals with the appropriateness of the outputs with respect to organizational goals and objectives and the ability of the transformation process to produce those outputs.

Seashore has stated that the ways in which organizations employ their informational resources underlie a model of organizational effectiveness called the decision-process model (Seashore, 1983: 60-61). Decision-process models view organizations as information processing and decision making entities. Seashore's model evaluates these against: rational standards of intrinsic goodness of decisions made, the appropriateness of the decision process, and the impact on systemic integrity or goal attainment. Seashore goes on to say that:

> ... the issue of fit of decision processes to the organization's situation is crucial and difficult, requiring differentiation among organizations as to their youth or

> maturity, whether in information-rich or information-poor environments, whether processing a relatively stable or instable goal structure, whether embedded in a simple or a complex array of institutional constituencies (Seashore, 1983: 61).

Another issue to be discussed is a suitable measure for effectiveness. Anthony points out that in profit-oriented organizations, the difference between revenues and expenses is a suitable measure of effectiveness in most cases. Profit as a measure of effectiveness has the following advantages: it is a single criterion that can be used in decision making to evaluate alternatives, it permits quantitative analysis where benefits can be directly related to costs, it provides a single measure of effectiveness, it permits decentralization, and facilitates comparison between different organizational elements (Anthony & Young, 1984: 39-40). For nonprofit organizations like the Air Force this is not the case. In fact "... in a nonprofit organization the difference between revenue and expense says nothing about effectiveness" (Anthony & Young, 1984: 19-20).

"A nonprofit organization is an organization whose goal is something other than earning a profit for its owners. Usually its goal is to provide services" (Anthony & Young, 1984: 35). Whereas in profit-oriented organizations decisions can be made using profit, in dollars, as an unambiguous measure of desirability, in nonprofit organizations this criteria is lacking. In nonprofit organizations

> ... decisions made by management are intended to result in the best possible service with the available resources; success is measured primarily by how much service the

> organizations provide and by how well these services are rendered (Anthony & Young, 1984: 35-36).

For the Air Force, in terms of its mission, measuring effectiveness is complicated by the fact that, as an organization, it is part of the political sphere as opposed to the economic or social sphere (Harrison, 1978:549). Also, the Air Force serves more than one constituency. In a given decision making situation, different groups might share an interest in the results while having diverse views on what constitutes success. Finally,

> ... military needs tend to be uncertain, and there are no generally accepted utilitarian criteria by which to judge the adequacy of military organizations. In fact, short of actual war, there is no direct test of the effectiveness of military organizations (Harrison, 1978: 554).

Given this scenario, managers require substantial inputs from both inside and outside the organization to help rationalize organizational objectives and to satisfy constituencies' divergent measures of effectiveness. The key sustaining input required is information. Without quality information about the many facets of the decision, the manager may come up with the right answer to the wrong question. Information is the most important ingredient to effective managerial decision making (Drucker, 1974: 471).

Drucker's discussion of effective management decision making draws heavily upon his observation of the Japanese approach to making 'decisions'. He notes that the Japanese, however, never really make decisions, at least as decisions are thought of in Western society. Instead, the Japanese spend considerable time gathering

information about the nature of the problem, whether it really exists, what the alternatives are, what pitfalls exist, etc.

> The Japanese process is focused on understanding the problem. The desired end result is action and behavior on the part of people ... they discipline themselves not to commit to a recommendation until they have fully defined the question and used the process of obtaining consensus to bring out the full range of alternatives (Drucker, 1974: 469-470).

This process of gaining consensus requires the transfer of considerable amounts of information among the decision making participants. This communications task in the Japanese example occurs during factfinding and coordinating meetings, of which there may be many. In Western organizations, the communications task is often a functional responsibility carried out in accordance with the defined procedures within the formal organizational structure. However, if the organization is faced with a unique problem that will require a complex and innovative solution, the existing information may not prove suitable to the challenge.

For the acquisition Program Manager, the issue of program management effectiveness centers on the ability to communicate information within the organizational context so as to efficiently accomplish the programs goals and objectives. Without an unambiguous measure of effectiveness like profit, the PM must rely on other organizational indications of the goodness of defined alternative courses of action. In this situation, management action must rely on an organizational consensus about the merit of the choice to be made. The Program Manager must ensure that the

managerial level decisions made conform to overall organizational expectations while at the same time satisfying the procedural requirements of the four acquisition system sub-processes.

Decision Analysis

Many decision support systems, or tools, have been designed and offered as the means to overcome the problem of insufficient information. These tools provide specific answers to problems that can be easily quantified and subjected to computer analysis. Post World War II operations research tools (e.g. optimization techniques such as linear programming) were effective primarily with operationally repetitive problems. In the 1950's, the field of management science developed to address higher level management problems. These efforts, however, tended to focus upon problems that could be solved with elegant mathematics (Matheson & Howard, 1983: 21-22). These mathematical models did not provide the decision maker with information about the problem itself - they provided little insight into the complex nature of the decision. Also, they did not explicitly address the problem of intra-organizational and extra-organizational communication.

Optimization techniques and elegant mathematics also required simplifying assumptions be made concerning both the nature of the decision and the operational characteristics of the system under examination. Three significant assumptions were that an objective function could be formed containing a single attribute for evaluation,

that outcomes were not subject to uncertainty (de Neuville, 1971: 87) and that decision makers maximized value or utility (Simon, 1959: 230).

The same was true of computer simulations. These highly complex computer programs included many implicit and subtle assumptions that affected the data they produced. As decision information was presented to groups further and further removed from the raw simulation data, upon which the decisions were originally based, the clarity of the intended message, in terms of assumptions, limitations, and risks, was diminished.

The assumptions employed in the tools of management science are necessary because the real world is complex and dynamic. Herbert Simon stated that even with these powerful new tools, "most real-life choices still lie beyond the reach of maximizing techniques - unless the situations are heroically simplified by drastic approximations " (Simon, 1959: 259) The real world and its problems are not simple and straight forward. They are messy. According to Howard Raiffa, there is an art rather than a science to analyzing real world problems (Raiffa, 1968: 239). The 'art' required is the understanding of the individual decision maker's perceptions of the environment and how he or she manages the process of choice.

> The principles and techniques of decision analysis offer the opportunity to deal with these problems. Decision analysis includes procedures and methodology for assessing the real nature of a situation in which a decision might be made, for capturing the essence of that situation in a formal but transparent manner, for formally 'solving' the decision problem, and for providing

insight and **motivation** to the decision-makers and implementers (Howard & Matheson, 1983: viii). [Emphasis added]

To allow decision analysis to be used in the development of a normative organizational decision making framework, however, it is necessary to discuss decision analysis principles and techniques with respect to the changed decision making environment found in large organizations. Conventional decision analysis was discussed in the literature primarily in terms of solitary decision makers making singular decisions. As discussed above, however, in large organizational decision making processes, decisions can be accomplished through a series of sequential lower level decisions each of which can be decided by one manager or several. It is also desirable to ensure that all the assumptions underlying decision analysis methodology are understood and consistent with the organizational decision making environment.

The basic approach to decision analysis decision making is a five step decision analysis cycle used by the Strategic Decisions Group, a well known practitioner of decision analysis (Matheson & Howard, 1983: 17-55). The baseline process is explained below.

Step 1: Decision basis development. The problem and decision required are defined in terms of three elements of the basis: the alternatives to be considered, the information required, and the preferences of the decision maker . The decision basis is the quantitative specification of the problem. The two essential steps in decision analysis are the development and evaluation of this decision basis (Howard, 1983: 11).

Step 2: Deterministic structuring. "The deterministic phase is essentially a systems analysis of the problem" (Matheson and Howard, 1968: 27). Within this phase there are two areas of activity: modeling and analysis. The modeling area consists of the following:

> 1. Bound the decision - specify exactly what decision is to be made. If alternative courses of action cannot be identified, the situation must be classified as a 'worry' and not an actual decision problem.
>
> 2. Identify alternatives - determine other alternatives. The identification of new alternatives never makes a decision more difficult and may in fact simplify the choice.
>
> 3. Establish outcomes - "... an outcomes is whatever the decision-maker would like to know in retrospect to determine how the problem came out. In a military problem, the outcome could be a complicated list of casualties, destruction, and armament expenditures" (Matheson and Howard, 1968: 27).
>
> 4. Select system variables - system variables are those variables upon which the outcomes of the decision depend. System variables are of two types. Decision variables are system variables that are under the decision-maker's control. State variables are the system variables not under the decision-maker's control.
>
> 5. Create a structural model - specify the relationships of the system variables in a way the captures the essential interdependencies of the problem. This should be done in a logically precise manner (e.g. mathematics, computer simulation language)

6. Create a value model - assigning a numerical (cardinal) value to each outcome. If the resources to be allocated by the decision are monetary, the value assigned to the outcome should be monetary also.

7. Create a time preference model - describing the preference of the decision-maker for the time value of the decision action. "Time preference is the term used to describe the human phenomenon of impatience.... This impatience is reflected in a willingness to consume less now rather than postpone the consumption" (Matheson and Howard, 1968: 29). The stream of value reduce to account for time preference is called 'worth'.

"The modeling part of the deterministic phase thus progresses from the original statement of the decision problem [the decision basis] to a formal description suitable for detailed examination by logical and computational analysis (Matheson and Howard, 1968: 29). Two analyses are accomplished as part of the deterministic phase.

1. Decision variable sensitivity analysis - By evaluating the range of value each decision variable might assume (all others held constant at a nominal value), determine that variable's effect on the worth of the decision. Those decision variables which have little effect upon the decision are called 'impotent' and can be removed from the decision basis. Other decision variables remain in the basis.

2. State variable sensitivity analysis - As above, each state variable is evaluated over the range of values it could assume, all others held constant. If the state variable has a great effect on the worth of the decision, then must be further analyzed. These state variables are called 'aleatory' (i.e. dependent upon chance). If the worth of the decision changes very little, then the variable can

be fixed at its nominal value. These state variables are called 'fixated'.

In summary, during the deterministic phase the variables relevant to the problem/decision are defined and their inter-relationships determined. Values are assigned to the variables and a sensitivity analysis is performed to measure the importance to the worth of the decision to each variable. Uncertainty is not considered.

Step 3: Probabalistic evaluation. The result of the sensitivity analyses accomplished during the deterministic phase is to identify the aleatory state variables. "The probabalistic phase determines the uncertainty in value and worth due to the aleatory variables" (Matheson and Howard, 1968: 30). As in the deterministic phase, the probabalistic phase is divided into modeling and analyses activities. The modeling area consists of the following:

1. Encode uncertainty - assign probability distributions to each of the aleatory variables. "Either the decision-maker or someone he designates must assign the probability that each aleatory variable will exceed any given value" (Matheson and Howard, 1968: 30). For detailed information concerning the specific techniques used to accomplish this see Spetzler and Stael von Holstein's "Probability Encoding in Decision Analysis", 1972: 601-625.

2. Encode risk preference - determine the decision-maker's attitude toward the worth of outcomes and the relationship towards uncertainty. Risk is the concept that relates the worth of an outcome to the uncertainty associated with that outcome. "A risk-averse decision-maker is willing to forego some expected value in order to be protected from

the possibilities of poor outcomes" (Matheson and Howard, 1968: 43). The concept of risk helps to evaluate choices where the values of the outcomes are the same but where different probabilities for the outcomes have been determined. For a detailed discussion of risk, see Howard's "Risk Preference", 1970: 627-663.

The analysis part of the probabalistic phase consists of the following:

1. Develop worth lotteries and Certainty Equivalent - a worth lottery is the probability distribution of worth for any setting of the decision variables. The certain equivalent worth of a lottery is "... the amount of worth received for certain, so that the decision-maker would be indifferent between receiving this worth and participating in the lottery" or, in other words, taking the chance (Matheson and Howard, 1968: 32).

2. Determine if stochastic dominance exists - determine if, for any value of a aleatory variable X, there is a greater probability of one alternative producing a worth in excess of that worth than will another alternative. If such a case exists, then the first alternative is said to 'stochastically dominate' the other. If such is the case, then there is no need to determine the risk preference of the decision-maker with respect to that choice.

3. Measure risk sensitivity - determine how the certain equivalent worth of the most favorable alternatives depend upon the decision-maker's attitudes toward risk.

In summary. during the probabalistic phase, probability assessments are made for each variable determined to be deterministically sensitive in Step 2. The decision maker's attitudes

toward risk are assessed. The probabilities and risk preferences are added to the model and sensitivity is measured again.

Step 4: Basis appraisal. An evaluation is made of the three elements of the basis to determine if additional information gathering or model review is required before the decision can be made. To a large degree this involves the manager's confidence in the information about the decision that has been gathered to date, and the estimated value of additional information that may be desired. The value of additional information is a marginal analysis of the cost versus benefits of the information being considered. The object is to determine the value of eliminating uncertainty in the aleatory variables.

When the benefits are determined to exceed the cost of the information, the cycle is iterated and the decision basis is updated. This process of iteration, update, and appraisal is continued until "... the value of new analysis and information-gathering will be less than its cost, and the decision to act will then be made (Matheson and Howard, 1968: 26).

Step 5: Decision and/or iteration. If additional information is not determined to be required, then the decision can be made. Otherwise, the cycle returns to Step 1.

Before proceeding to apply the decision analysis model to the situation faced by the acquisition Program Manager, working in a large bureaucratic organization such as the Air Force, the assumptions and underlying theoretical foundations of decision analysis will be reviewed. Howard has stated that decision analysis

is concerned only with individual decisions. Group decisions, as found in a large organizations like the Air Force, are not considered (Howard, 1983: 181).

Raiffa, on the other hand, addresses this group decision making situation using decision analysis in some detail. His discussion centers on the applicability of individual decision making behavioral assumptions to the group, or organizational, situation (Raiffa, 1968: 233).

Summary

This chapter has laid a foundation for further study of the decision making situation faced by the acquisition Program Manager. The organizational structure of the overall acquisition system was shown to be comprised of four interrelated sub-processes. These sub-processes were then shown to be susceptible to the influence of environmental forces. These in turn complicated the decision making task of the acquisition Program Manager.

Management theory was reviewed in terms of organizational structure and organizational effectiveness. The Air Force acquisition system was determined to be essentially bureaucratic but the consideration of the open systems theory and the socio-technical systems theory provided additional knowledge about the complexities of the acquisition situation.

Finally, decision analysis was offered as a way to assist the PM is the decision making task. The five-step decision analysis cycle was

briefly explained. However, the ready applicability of the decision analysis cycle to large organizations was left in question.

The following chapter will present a method for analyzing a recent Air Force acquisition decision. The decision will be compared against a normative organizational decision making model which is developed in Chapter IV. Chapter V will present the results of the analysis and Chapter VI will summarize, draw conclusions and present recommendations.

III. Methodology

Introduction

This research effort was structured to determine whether the selective application of decision analysis principles and procedures, within a coherent normative decision making framework, could be used to improve the Air Force acquisition Program Manager's decision making. Part of the problem was to determine the extent to which decision analysis tasks were already being accomplished.

Specifically, the study developed a normative model as an overall management decision making framework. The normative model was based upon the results of the literature review summarized in chapter II and was intended to be suitable for use by Air Force acquisition Program Managers. Since an objective of this study was to draw conclusions about the applicability of the model as a guide for acquisition PMs, it was necessary to test, or validate, the model using an actual Air Force acquisition decision.

Therefore, the purpose of this chapter is to define how a recent Air Force acquisition decision was compared to the normative model so that the applicability of the model could be determined as well as the extent to which relevant tasks were already being accomplished. The tasks of the analysis will be discussed, variables defined, and statistical tests explained.

Analysis Tasks

After the literature review was completed, it was determined that an important part of this study would be the choice of a recent Air Force decision for use as a descriptive acquisition decision making baseline. A case study of a real decision was needed to provide the necessary links to future implementation and research.

The first objective of the case study was to provide a solid and realistic foundation as the practical point of reference for drawing conclusions about the applicability of the overall normative framework which included the decision analysis principles. Secondly, it was desirable to determine if existing procedures within the acquisition system provided the information required by decision analysis. Implementation planning for a new system must consider the total situation into which it will be placed in order to have any probability of success. Implementation planning should therefore begin early in system design (Conner, 1985: 27).

The Air Defense Fighter (ADF) Competition was chosen for several reasons. The ADF Competition was a large, complex program, both technically and programmatically. The decision resulted from the efforts of many people from numerous organizations and managerial levels within those organizations. Significant issues surrounded the competition, several of which were political. These issues sprang directly from the acquisition reform movement, of which the environmental changes discussed in the literature review were prime examples.

The ADF Competition, however, was initiated by the unsolicited Northrup F-20 proposal, which was seen by many, including the Congress, as an opportunity to increase competition in tactical fighter procurement (Gordon, 1985: 1611). This aspect could cause the competition to be viewed as atypical of DOD weapon system acquisition programs. It was assumed, however, that most acquisition programs are affected in their early stages by defense industry marketing activity. It was determined that it would be beyond the scope of this study to attempt to ascertain the relative influence upon the acquisition system of these various influences. Additionally, it was assumed that any influence there was would not change the conclusions of the study. Instead, it is simply another example of the complex and dynamic nature of the management of weapon system acquisitions. For these reasons the ADF program was judged by the author to be an acceptable example of current major Air Force acquisition decisions.

The ADF decision was analyzed from approximately the point in time when the initial unsolicited bid from Northrup Corporation was received by the Air Force to just prior to the final award of a contract to General Dynamics Corporation. This 'history' was prepared, and organized, according to the sequence of steps associated with the scientific method or traditional problem solving process: identify the problem, define alternative solutions, gather data necessary to evaluate the alternatives, evaluate the alternatives, and finally make the choice (Borg and Gall, 1971: 7-8). These steps were chosen as a common denominator for the overall analysis

because of their relative simplicity, comprehensive nature, and the familiarity managers have with the steps.

Key Variables. Within the context of the traditional problem solving phases, an analysis was accomplished of the ADF competition from the perspective of the acquisition Program Manager in terms of Air Force acquisition decision making. The analysis focused on two key variables: the creation of information and the communication of information. These key variables, information and communication, are discussed below.

Information Processes. For an individual, the following table defines information related phases of a decision process (Ebert & Mitchell, 1975: 67).

Table 1

Information Use During a Decision Process

Acquisition	Processing	Output
Search behavior	Information utilization	Judgment

Within an organizational context, and the Air Force weapon system acquisition process, the information processes used in the problem solving process become critical. The purpose of this decision making variable is to reveal the manner in which ADF Competition Program Manager created and processed information. The study was interested in determining the nature of information search

activities and how that information was used in the decision making process. The judgment phase was determined to be not applicable to the objectives of this study.

Communication Processes. "The collection, evaluation, and transmission of information can vitally affect organizational and individual performance" (Hellriegel and Slocum, 1974: 266). The communication process determines the hierarchical direction of the flow of information, who sends and receives the information, the quantity of information transmitted, and the timing of the transmission. Each of these aspects of the communication process has a great affect upon the effectiveness of the decision making process. In the Air Force acquisition decision making process, these communication flows are often very formalized. Informal transmission mechanisms, however, cannot be ruled out a priori as not having influence over results. The analysis sought to identify the flows of communications and whom the communications were with.

Mitigating Variables. Throughout the ADF competition problem solving process, and associated with each key variable, there existed aspects of the Air Force decision making context that were identified and discussed with regards to their impact upon the analysis. Inclusion of these aspects is necessary to facilitate an understanding of the process of decision making as a group process within an organization. These aspects are termed mitigating variables and are discussed below.

Organizational Structure. The structure of the Air Force acquisition process refers to the organizational elements assigned the overall responsibility for the process, the definition of the tasks they are to accomplish, and the formal relationships between elements. This structure may or may not mirror the structure of information flows defined by the communication process although there is assumed to be considerable overlap. The key issues were the extent to which the formal organizational structure supported the objectives of the decision making process and whether any apparent structural dissonance significantly impeded the efforts of the organization to solve the problem.

Established Procedures. As mentioned above, the Air Force major weapon system acquisition process is highly formalized. It was shown in the literature review that this formalization takes the form of four separate but inter-dependant acquisition sub-processes. Many governmental agencies have enacted regulations governing how these sub-processes are to proceed. Given the complexity of this regulatory environment, these procedures may vary from one problem solving phase to another, and may have effected one key decision variable differently from the other.

External Influences. This mitigating variable was primarily concerned with political influences upon the decision making process. In the case of the ADF Competition, these influences originated from the Congress, the media and other organizational elements. External influences tended to be transmitted primarily through the budget process.

Personnel. The particular personnel assignments in affect at a given time can greatly influence many of the administrative decisions made during a problem solving process. For example, a manager with a substantial engineering background might react differently to a certain aspect of the problem than would a pilot with substantial operating experience. Established procedures may or may not have always corrected for this tendency.

Data Categorization Scheme. The data from the analysis, throughout the traditional problem solving steps, was categorized in terms of the key variables and mitigating variables. The scheme to accomplished this task was content analysis. The categorized data were then correlated to the primary attributes of the proposed normative framework (developed in the next chapter). Since this study was primarily concerned with information and communication, and since it was presumed that significant communication was primarily accomplished via the transmission of written documents from one organization to another, the source material used for the analysis was limited to the documents maintained by the ADF Program Manager and the ADF Competition management team. The actual Request for Proposal (RFP) issued to the interested and qualified contractors was also an important documented source.

"Content analysis is a method of studying and analyzing communications in a systematic, objective and quantitative manner for the purpose of measuring variables" (Kerlinger, 1964: 544). The first step in doing the content analysis study, was to define the

universe of content to be analyzed. For the ADF Competition, the universe was defined as the collection of documents assembled by the Program Manager.of the competition. This documentation included most unclassified correspondence and other written materials from 2 April 1985 until 31 October 1986. The RFP was also defined to be within the universe.

The second step was to determine the appropriate unit for the analysis of the universe. In the ADF Competition, the units were defined as the individual documents themselves. For example, a letter from the Program Manager to the headquarters would be a unit. However, when a document had attachments that were by themselves formal communications concerning the competition, those documents were treated as separate units. For example, a letter sent to the Program Manager from the headquarters would be a unit as would an attached memorandum from the DOD to the Secretary of the Air Force.

The next step was to break down the universe into major categories. Categories are the first level of the actual content analysis. The categories chosen for the ADF Competition were the:

1. Control category,
2. Problem solving steps,
3. Weapon System Acquisition (WSA) sub-processes,
4. Information processes,
5. Communication processes, and
6. Critical decision analysis tasks.

Each major category was then divided into subcategories. All subcategories are shown in Figure 11. Definitions of each subcategory follow below.

Control Category. The subcategories under the category Control follow.

Book: The binder the document was located in.

Tab: The tab the document was filed behind.

Date: The date of the document.

To: The organization to which the document was primarily addressed.

From: The organization primarily responsible for generating the document.

Subject: The stated subject or title of the document.

Purpose: A brief synopsis of the intended purpose of the document.

Problem Solving Step Category. The subcategories under the category Problem Solving Step follow.

Problem Definition: Determine whether the document supported the activity of problem definition.

Identification of Alternatives: Determine whether the document supported the efforts of the decision making unit and the Program Manager to identify alternative courses of action. Decisions made during the definition of the problem phase impact how the identification of alternatives phase will progress. Alternatives in the acquisition process take on two forms. First, will the actual program be managed as a sole source procurement from a single prime

Universe: ADF Program Manager's Correspondence File		**Units:** Program Management Documents
Categories	**Sub-categories**	**Elements**
Control	•Date	Apr 85 thru Oct 86 (19)
	•Book •Tab •To: •From: •Subject •Purpose	As appropriate
Problem Solving Steps	•Problem Definition •Identification of Alternatives •Gather Data •Evaluation of Alternatives •Decision	Yes or No(2)
Weapon System Acquisition Sub-Processes	•Requirements •Budget •Acquisition Management •Contracting	Yes or No(2)
Information Processes	•Environmental Influence •Provide Information •External Policy •Information Source •External Tasking	Yes or No(2)
Communication Processes	•Direction of Flow	Not Aplicable (NA) Incoming Unknown (UNK) Outgoing Internal (5)
	•Intra-Organizational Coordination •Extra-Organizational Coordination	Yes or No (2)
Critical Decision Analysis Tasks	•Outcomes •Preferences •Variables •Models •Uncertainty •Probability •Values •Risk	Yes or No (2)

Figure 10

ADF Comparative Analysis Variables

contractor or as a competition between two or more contractors. Second, will be the set of technical approaches for the conduct of the program proposed by the single contractor or by competing contractors.

In each of these instances, information was used to justify the definition of alternatives. Similarly, the existing Air Force acquisition system will affect this process through its specific communication channels. Documents from the ADF Competition were analyzed to trace the flow of this process.

Gather Data: Determine whether the document supported the data gathering activities of the decision making unit. Documents were categorized as data gathering whether the data were gathered to support problem definition, alternative identification, or for some other purpose.

The evaluation of the alternatives depended heavily on the data that were gathered to support the evaluation. The data chosen depended upon the sources of information known to exist by the personnel involved in the decision making process and by the mechanisms employed by the process itself to find and/or generate data. Similarly, the extent to which the existing communication channels allowed, or even encouraged, this search could have significant affects on the eventual conduct of the evaluation of alternatives.

Evaluation of Alternatives: Determine whether the document supported alternative evaluation activity. The purpose of the evaluation phase is to process relevant data about the alternatives

into useful information that will allow an informed choice to be made. The success of this processing depends upon the tools available and the clarity of the objectives of the evaluation. The tools available for evaluations vary considerably in their nature, assumptions and products. The use of the tools must be guided by the overall objectives of the evaluation phase. The product of the tools must be coherent between the tools and between the alternatives evaluated. The ability to choose between alternatives is contingent upon clear comparisons of meaningful information about the alternatives.

Decision: Determine whether the document established a final choice. The final decision is based upon the results of the previous phases of the problem solving process. Weakness in any of the preceding actions will undermine the quality of the final choice. The choice in the Air Force acquisition process involves not only choosing an alternative, but also justifying the choice to others. This process of justification, and its anticipation by decision making participants, affects the actions of the participants throughout the process.

Weapon System Acquisition Process - Sub-Process Category. The subcategories under the acquisition sub-processes are discussed below. The sub-processes, discussed thoroughly in the literature review, included:

Requirements Sub-Process: Determine whether the document supported the preparation of a validated Statement of Operational Need (SON).

Budget Sub-Process: Determine whether the document supported the preparation or update of the Program Objective Memorandum (POM).

Acquisition Management Sub-Process: Determine whether the document supported the preparation of the Program Management Directive (PMD) or whether the document supported the activities of the Program Manager with regards to the general management of the program (i.e. activities relating to program documentation not covered in the other three sub-processes).

Contracting Sub-Process: Determine whether the document supported the issuance of the Request for Proposal (RFP),.the subsequent proposal evaluation and the contract award activities.

Information Process Category. The subcategories under the information process category are defined below.

Environmental Influence: Determine whether the document constituted an influence upon the conduct of the program originating in the environment.

Provide Information: Determine if the document was intended to convey information to others.

Information Source: Determine whether the document was intended to be used as a reference source for information.

External Tasking: Determine if the document constituted a tasking of the specific program (ADF Competition) by an organization external to the immediate decision making unit (e.g. DOD, Congress, etc.).

External Policy: Determine if the document reflected general policy guidelines applicable to several programs.

Information Search Activity: Determine if the document initiated a search for information (i.e. did the document request information from another organization to support the program).

Communication Process Category. The subcategories under the communication process category are defined below.

Direction of Flow: Determine if the document was incoming or outgoing with respect to the program organization. Determine if the document was used as an internal medium. If the document was none of these, list as Not Applicable (NA). If the document flow could not be determined, list as Unknown (UNK).

Intra-organizational Coordination: Determine whether the document was used to gain internal program consensus on an issue.

Extra-organizational Coordination: Determine whether the document was used to gain consensus from relevant external organizations with respect to an issue.

Critical Decision Analysis Tasks Category. Listed below are the subcategories under the critical decision analysis tasks category.

Outcomes: Determine if the document provided information that could support the identification of possible decision outcomes.

Preferences: Determine if the document provided information that could support the definition of organizational preferences.

Variables: Determine if the document provided information concerning decision and/or system variables.

Models: Determine if the document provided information concerning the evaluation of alternatives using quantitative analysis (e.g. computer simulations)

Uncertainty: Determine if the document acknowledged that future events were uncertain.

Probabilities: Determine if the document provided information about the probability of a future event occurring.

Values: Determine if the document provided information about the value placed upon a decision outcome by the organization.

Risk: Determine if the document provided information that acknowledged the position of the organization on the possible negative results that could follow the decision.

Depending on the subcategory, the method to quantify the categorization varied. For the subcategory "date", there were nineteen elements ranging from April 1985 to October 1986. The remaining control subcategories contained information relevant to locating and describing the document but were not used in the statistical analysis. The direction of flow subcategory had five elements: not applicable, incoming, unknown, outgoing, or internal. The remaining subcategories were defined by either a yes or no answer.

Data Analysis Approach. Insofar as the data obtained from the content analysis described above was nominal data, it was necessary to define a statistical test of correlation that was appropriate. Siegel has stated that "... the most common measure of association for nominal data is the contingency coefficient, C, a nonparametric

statistic" (Siegel, 1956: 23). The contingency coefficient measures the degree of association between two variables (Siegel, 1956: 195-202; Harnett, 1982: 718; and McClave and Benson, 1985: 799). The relevant assumptions were that all the data were nominal, that no fewer than 20% of the contingency table cells have an expected frequency of less than five, and that no cell had an expected frequency of less than one (Siegel, 1956: 201).

The data were analyzed in the Statview 512+ software package using the contingency table function while varying the definition of x and y variables. The software produced contingency tables in the following forms: observed frequency table, percent of rows table, percent of column table, and an expected values table. Also created was a table listing the degrees of freedom, the contingency coefficient, and the p-value for that test (Cuneo and Feldman, 1986: 137-140).

The tests run had degrees of freedom of 18, 4, or 1. The null hypothesis (H_0)was that the variables compared were statistically independent. The alternative hypothesis (H_a) was that the variables compared were dependant. The rejection region, at a .05 level of significance, was defined at the following values of chi square (X^2): 28.9 for 18df, 9.49 for 4df, and 3.84 for 1df (Beyer, 1968: 294).

Tests were run in accordance with Figure 11. Shown are the categories (and two subcategories - time and flow) which defined the comparisons. These comparisons were chosen because they were relevant to the objectives of determining if the normative model's tasks could be accomplished in the system currently in existence.

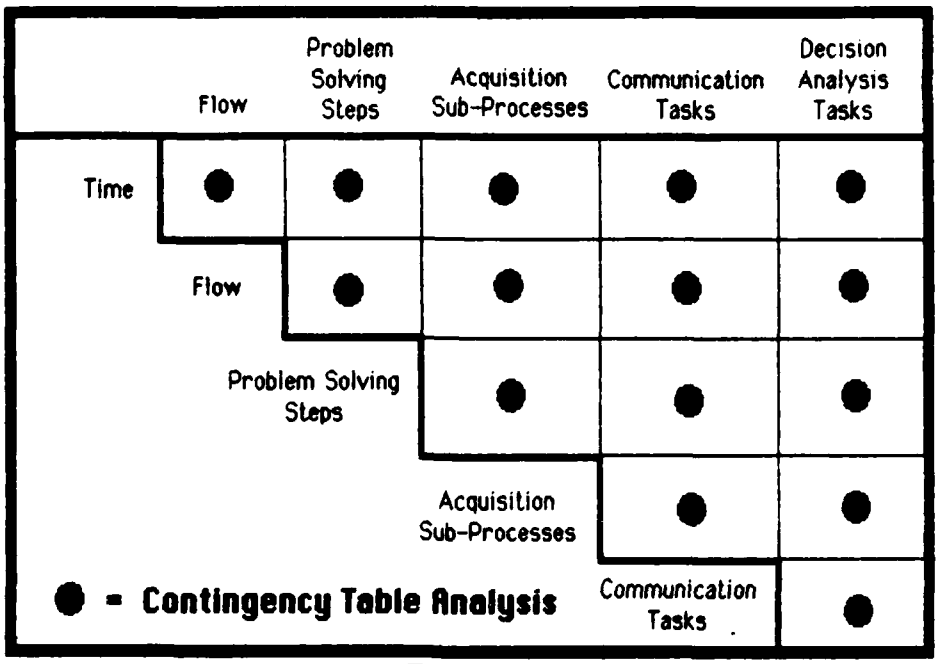

Figure 11

Matrix of Variable Comparisons

For example, the analysis would show whether the decision analysis tasks of determining values correlated with the acquisition requirements sub-process. Or, it might show that requirements related documentation occurred early in the decision making process.

Summary

This chapter defined the method of analysis of the chosen acquisition decision example and its documentation. The overall analysis relied upon content analysis to characterize and categorize the data . The data were then statistically analyzed using contingency tables and the contingency coefficient. The intent of the comparisons was to identify possible significant correlation between relevant variables.

IV. Model Development

Introduction

In this chapter, the five-step decision analysis cycle introduced in the literature review is decomposed to focus on those facets of the methodology critical to its transition from an individual decision making context to that of group decision making in an organization. The decision analysis cycle is then recomposed into a form consistent with organizational decision making and, lastly, evaluated for theoretical applicability to Air Force acquisition decision making prior to the comparative analysis of the ADF competition in Chapter V.

Decomposition

Decision analysis principles are based upon theoretical assumptions and groundrules for their application. Three aspects of decision making, as they pertain to the use of decision analysis in an organization, are discussed below. Each aspect was chosen because of its significance to the application of decision analysis principles in a group decision making situation as typically found in bureaucratic organizations.

Decision Definition. As mentioned in Chapter II, Howard's view of decision making excludes explicit consideration of a group process. Howard mentions an individual, acting alone, as the decision maker. This individual is able to provide a single set of preferences, alternatives, outcomes, and probabilities that the decision analyst can

use. Similarly, there exists a single attribute (usually money) that can be used to unambiguously evaluate and rank the alternatives. Once the optimum alternative is determined, a single irrevocable act implements the decision (Howard, 1983: 181-184).

In a group decision making context, the decision making process must often balance competing goals. These goals may arise from the different constituencies being served by the organization or from an inability to discriminate between multiple goals (Steiner, et al, 1982: 517-522). Consider the four generic acquisition goals of cost, schedule, performance, and reliability & maintainability as an example of this goal conflict. There may exist simultaneous requirements to increase an aircraft's operational range, decrease its life cycle cost, and stabilize its gross takeoff weight. The ability to arrive at a single measure of the effectiveness of alternatives to satisfy these goals, agreeable to different individuals and organizational elements (particularly in the nonprofit arena), is operationally difficult (Anthony & Young, 1984: 42; and Harrison, 1974: 554).

Organizational decision processes also include reviews of the decision once it has been made. There can be a number of reviews before the actual decision is validated by the corporate whole. Drucker terms this activity the 'selling' of a decision (Drucker, 1974: 468). In the Air Force, a primary vehicle in making an important decision is 'briefing' that decision to other interested organizations. The concept of 'selling' is also discussed by Loving. The interface with other organizational elements is said to be critical because such "... **coordination** serves to insure that the left hand knows what

the right hand is doing and agrees - - so that the staff then acts in concert" (ACSC, 1986: 22) [Emphasis added]. As an example, important resource allocation decisions must be handled in a formal and specified manner using the procedures dictated by the Planning, Programming, and Budgeting System (PPBS) and the Air Force Board Structure, as discussed in Chapter II.

Decision analysis, if it is to be implemented within an organization, must explicitly account for this process if it is to be successful. The definition of a decision, at least in the large bureaucratic organization, must recognize the formal coordination process in which decisions are formulated, resolved, and implemented.

Rationality. The concept of rationality can be associated with the decision itself or with the process followed to arrive at the decision. A decision itself is rational if it maximizes the achievement of a goal within environmental limitations (Dahl & Lindblom, 1953: 38). Rational decision making as a process, however, concerns the procedures that should be followed to arrive at a decision. This normative aspect is consistent with the basic principles of decision analysis (Matheson & Howard, 1983: 25).

To make rational decisions, the following are required (Hellriegel & Slocum, 1974: 152):

1. The search for and assimilation of all information relevant to the decision issue.

2. The ability to determine preferences according to some measuring device.

3. The ability to select the alternative which maximizes the decision maker's satisfaction.

The availability of information of the right kind and at the right time to support the decision making process is problematic. One of the key reasons for supporting decision analysis in the organization is to increase the decision maker's ability to bring to bear upon the decision the best information in the optimum structure available (Raiffa, 1968: 268-272). Remembering that the definition of information discussed in Chapter II called for a structuring of data at a point in time by a specific person to serve a specific purpose, decision analysis must then provide support for the accomplishment of this activity by the Program Manager. Additionally, since information is a scarce resource, the decision analysis cycle must provide and utilize this information efficiently. The cycle must not be allowed to iterate beyond the point when the value of additional information exceeds its utility.

However, whether or not the PM is successful depends not only upon the inherent rationality of the process but also upon how well the process is implemented within the organization to begin with. To incorporate the principles of decision analysis into an organization requires that management data to support the process be made available and that the personnel involved with the cycle understand not only its strengths but also its weaknesses (Raiffa, 1968: 262).

Utility theory provides a measure of the preferences of a decision maker. Techniques exist that describe how to document the utility function of a decision maker through a question and answer session. The questions employ simple lotteries (i.e. sets of choices) to

estimate the utility function - the amount of 'goodness' the decision maker feels as value increases (Howard, 1983: 601-625). As mentioned above, Howard's view of decision analysis excludes group decision making. In an organization, however, this may often be the governing situation (Steiner, et al, 1974: 520).

Raiffa addresses group decision making by contrasting two divergent views of optimization. On the one hand, the group is able to arrive at 'compromise' probabilities and utilities which can then be used just as if they came from an individual with no change to the decision analysis process. On the other, the group debates and discusses the issues underlying the decision and arrives at a 'consensus' decision such that no other alternative will make any one individual better off that does not make someone worse off. This condition is known as Pareto-optimality (Raiffa, 1968: 234).

The degree to which one method of gaining group consensus about organizational preferences is better than another will depend upon the organization into which the methods are asked to work (Hellriegel & Slocum, 1974: 151-152). In the Air Force, while there is a strong tradition of decision making by group consensus, the specification of organizational values a priori is weak. While directives, regulations, office instructions and Commanders' policy letters exist, they tend to be either general in nature or not applicable in all cases.

Another rationality issue deals with the rules employed to determine which of the decision alternative being considered is the optimum. Simon maintains that the theoretical requirements for

long-run equilibrium (i.e. an overall optimum, a global maximum) implied by maximizing are not realistic. He states that " there is no a priori reason to assume long-run equilibrium" (Simon, 1959 263) given the complex and dynamic environment the organization faces. Instead, 'satisficing' decision making requires only a limited search of alternatives with the optimum being the one that is most acceptable but not necessarily the best. He goes on to say that satisficing models of decision behavior more closely relate to how individuals in firms actually make decisions (Simon, 1959 262-265).

The satisficing concept is worth considering here insofar as invalid assumptions operative during organization design, or used to support the mandates of a new directives and management systems, stand to, at best, confuse those charged with making decisions within that structure. Alternative assumptions might alleviate bottlenecks and false starts from occurring later on during actual decision making activity. The PM might not have to improvise as much or spend time finding ways to circumvent an unrealistic and constraining system.

In summary, the theoretical concept of rationality through maximizing does not appear ideally suited for use in assessing the decision making processes of large organizations. Rationality based upon rules of satisficing, however, is a descriptive model that offers little in the way of specific guidance for a Program Manager about to initiate a decision making process. Still, strict rationality as a governing assumption, implies too rigid a view of the decision making process and should not be used to support organizational design

decisions (e.g. structural alignments and procedural definitions) This is particularly true given the group context within which the decision making process is carried out and the significant environmental influences with which the process must contend. Loosening the assumptions of rationality allow a more realistic and flexible process to be implemented within the organization resulting in more efficient decisions concerning the value of additional information generation activities. Raiffa underscored that point when he wrote that "... a precise answer to the wrong question is not nearly so desirable as an incomplete answer to the right one (1968: 265).

Politics. When assessing problems in the context of decision analysis in organizations, there are two dimensions to consider. The first is the technical dimension of the decision. It deals with the specific facts pertaining to the system or systems under study. The technical dimension is the area that receives most of the attention of 'management scientists'.

In a recent talk on the application of management science to the military, Professor Gene Woolsey introduced another dimension. He pointed out that while the technical dimension is important in linking the problem with its solution, so too is the political dimension. The political dimension embodies consideration of the organization and how the solution decided upon must eventually be implemented. Woolsey stated that the traditional emphasis of management science is on the technical, while the political is where the real emphasis

should be. Similar to Drucker, Woolsey believes that the "...right answer unused is the wrong answer" (Woolsey, 1987).

As introduced in the literature review, the open systems and socio-technical models of management both explicitly address the environment within which the organization must make its decision. In the open systems model, the system itself influences and is influenced by the environment. Inputs are received from the environment and the system's outputs are provided to the environment. The socio-technical system model includes environment as a discrete input along with human, technical and managerial inputs which are also, at least indirectly, received from and influenced by the environment. The systemic outputs of production and innovation appear to be analogous to the outputs of the systems model. The socio-technical model adds the dimension more clearly of the environment also acting upon the social and technical elements of socio-technical behavior. Interactions and sentiments are obviously areas of social behavior subject to the influences of environment. Technology is also subject to the influence of the environment.

As discussed in Chapter II, the four organizational sub-processes at work in the overall weapon system acquisition process can be affected by changes in the environment. Only by addressing throughout the decision making process the affects upon the decision maker of the organizational politics involved in coordinating information and obtaining a consensus which validates the decision,

will the process be able to efficiently arrive at an effective solution to the specific problem under review.

The discussion above emphasizes the following points that should be considered when implementing decision analysis into an organization. First, the implementation should allow for group decision making. This should include gaining group consensus on all aspects of the decision to be made. The group should agree on the definition of the problem, the nature of the decision, the alternative solutions, what data are applicable, what evaluation methods will be used, and what decision will be made. Second, the implementation must be structured with explicit rules that acknowledge the cost of additional information. Program Managers should have the means to make rational decisions within a framework that processes information requirements rationally. Third, the implementation should address the open systems nature of organizational decision making. Numerous constituencies impact the alternatives considered and the choices made. Provisions for easy communication of decision relevant information between and among all decision participants should be provided.

Recomposition

The baseline five-step decision analysis cycle offers the decision maker increased effectiveness through structured information generation and transfer. As discussed above, however, the five-step cycle cannot be used directly in an organizational context, such as

that faced by the acquisition Program Manager. The DOD acquisition context requires group decisions in a complex environment that concern problems which involve the differing requirements of the four acquisition sub-processes and thus cannot always be optimized by simple maximization. Therefore, the decision analysis cycle must be restated in a form that accommodates the organizational decision making situation of the Program Manager.

The Organizational Decision Analysis Model (ODAM) will be discussed in a way that parallels the general systems theory approach to viewing organizations. The systems approach sees organizations as open-systems. The organization is made up of interdependent parts that both contribute outputs to, and receive inputs from, the whole. The entire organization is also interdependent with its external environment. The organization, as an open-system (at all levels), takes inputs of information, energy, and materials and transforms these by some process into outputs or products. Like the inputs, the outputs can take the form of information, energy and materials (Hellriegel & Slocum, 1974: 65).

While the ODAM borrows its general form from the open systems theory of management, the theory of bureaucracy and the socio-technical systems theory make valuable contributions. An important caveat of this study was that radical prescriptions for organizational change, whether in terms of structure or procedures, would not constitute a realistic solution for the acquisition PM. It would not be politically feasible to attempt to implement such changes. As Harrison stated, the military is a bureaucracy with

long-standing traditions concerning its methods of management and decision making (Harrison, 1978: 555, 598). This is particularly true about how the military determines objectives, values, and preferences. The ODAM was built based upon the premise that little or no significant change must be required to use the decision analysis techniques.

Socio-technical systems theory addresses concerns not usually found in solutions to the military's organizational decision making problems. Those concerns are the social elements of personal interactions and sentiments, and the technical element of the processes used in the organization. For example:

1. Program Managers vary from individual to individual.

2. The staff of the Program Office will vary from program to program.

3. The problems faced and the resulting decisions that will be required will vary from time to time.

Methods for structuring data and improving decision making processes should explicitly address these realities. Similarly, the individuals participating in the decision making process will inevitably introduce their own particular biases and inconsistencies into the process. Therefore, the structured process proposed should ensure that all aspects of the problem are explicitly documented so that at any step in the decision making process, other decision making participants within the group can challenge assumptions, criteria, or evaluations so that an improved solution can be found. Finally, as discussed in Chapter II, the four acquisition sub-processes

at work in the weapon system acquisition arena are interwoven. The interdependent nature of the sub-processes should be taken as given and all aspects of their interaction explicitly addressed during the decision making process.

Another approach exists to define rationality with respect to decision making by organizations. Simon states that, in general,

> ... rationality is concerned with the selection of preferred behavior alternatives in terms of some system of values whereby the consequences of behavior can be evaluated (Simon, 1976: 75).

The concept, termed 'bounded rationality', goes on to offer three elements to explain the conflicts and differences between individuals making decisions (Hellriegel & Slocum, 1974: 153-155).

The elements are:

> 1. Instead of seeking a single optimum action, an individual might establish a limited range of alternatives that would result in satisfactory outcomes.
>
> 2. Individuals, or organizations, are assumed to undertake a restricted search for possible alternatives.
>
> 3. Factors outside the control of the decision maker(s) will affect the outcome of the decision

As a prescription for designing an organizational decision making framework, the concept of bounded rationality at least partially resolves the issue that decision makers, whether individuals or organizational entities, will frequently have incomplete knowledge on the decision problem they face. Simon concludes that the theory of the organization must include as a basic element the fact that the

function of communicating, and the technology within the organization for its accomplishment, are critical considerations for effective organizational decision making (Simon, 1976: 243-244).

The heart of the debate with respect to rules of rationality mostly concerns the limits that the organization, or individual decision maker, is willing to go to in order to acquire marginally beneficial information. If the organizational norm is to get all the information, regardless of the cost, this would be considered a rational process. Too often organizations are encouraged to continue information search activity because of the fear that someone may be able to successfully challenge the problem formulation and subsequent decision. Additional information search is intended to minimize the possibility of that occurring. A more profitable use of the resources expended thus would be to structure the decision process rationally from the beginning so that subsequent defense and justification of the decision would be easier (although still not certain of success).

The decision analysis cycle, unaltered, would contribute significantly to the organization's efforts to communicate during its decision making process. By viewing the cycle, somewhat modified, as a entity in and of itself fitting into a larger organizational decision analysis process, the limitations discussed above can be minimized. The ODAM is discussed below in terms of inputs, process, and outputs.

Three Levels. The DOD acquisition organizational structure is a large hierarchical bureaucracy. The boundaries of the acquisition

bureaucracy, viewed as an open system, can be defined in terms of those organizational elements that fall within the system and those that are part of the systems environment. The environment is defined as those elements that affect the system but are not controllable by the system. For this study, because of its focus on the Air Force acquisition PM, the system was defined as the Air Force acquisition community. Figure 12 below illustrates the breakout of elements into either the environment or the system.

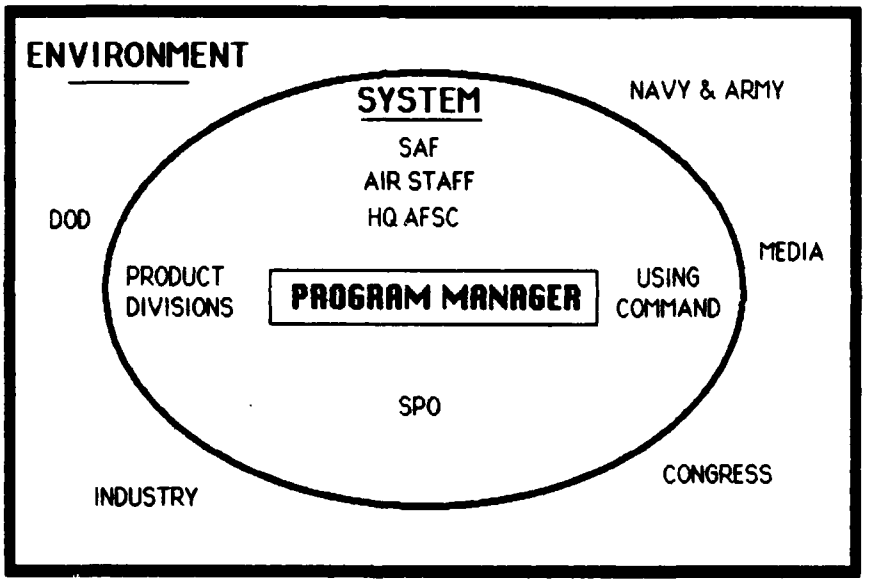

Figure 12

System Boundaries

Within the total Air Force acquisition system, are many nested subsystems. The Requirements, Budget, Acquisition Management and Contracting sub-processes are examples of such nesting. The system also contains levels of organization directives that prescribe how the activities of each of the sub-processes are to occur and be

documented. While at the overall organizational level (directives and regulations) and at the supporting level (operating instructions) detailed guidance is provided to the PM, a framework is not provided to the decision maker covering the complex interface of these sub-processes and levels of guidance. The ODAM is structured in nested levels in a complimentary fashion to alleviate this problem. Specifically, the ODAM includes a Managerial Level as the interface between the Organizational Level's goal oriented directives and the Supporting Level's detailed instructions. Figure 13 illustrates the relative positions of the three levels and the communication activity that takes place between each.

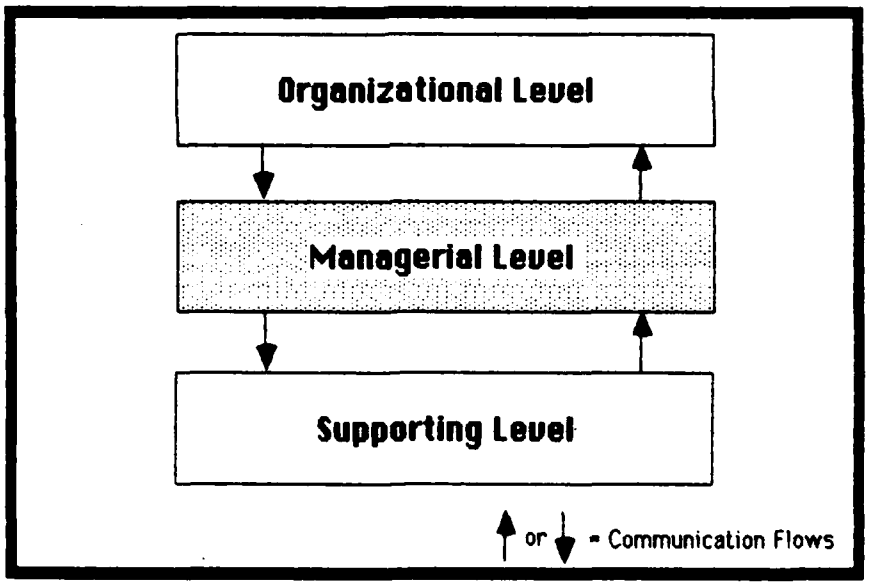

Figure 13

ODAM Levels

The three levels proposed are an Organizational Level, a Managerial Level and a Supporting Level. Each level is defined

below. The definitions are referenced to the perspective of the Air Force acquisition Program Manager.

Organizational Level. The organizational level is analogous to the broader organizational processes and sub-processes. It is at this level that program resources, goals, objectives and many of the constraints are determined. Figure 14 illustrates the make up of the organizational level.

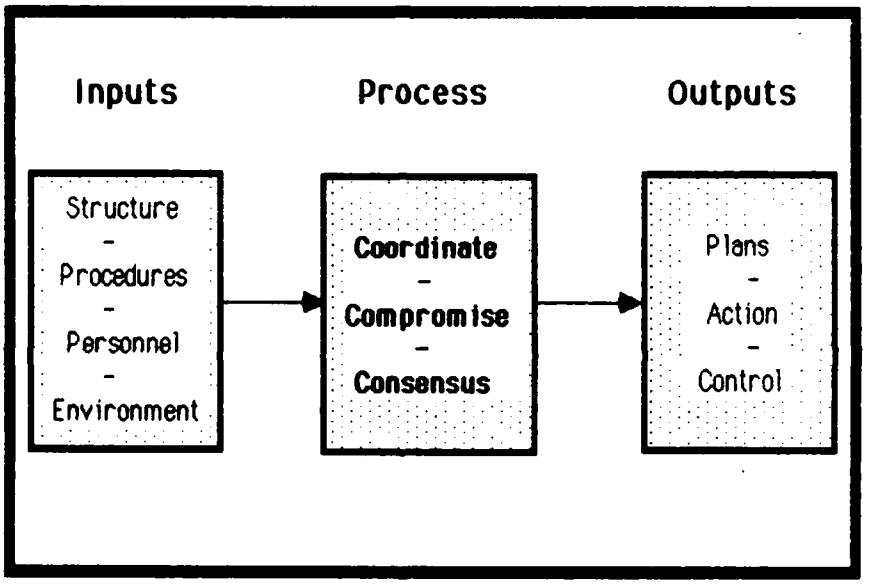

Figure 14

Organizational Level

The organizational level is also the primary location of the organization's boundary scanning activity (i.e. the activity to gather and input into the organization relevant evironmental changes). Coordination, compromise and consensus at the Organization Level involve organizational elements within the Air Force but outside the control of the Program Manager. Procedures are described in

moderate detail but tend to be relatively inflexible. Positional authority is very important while expert knowledge is less critical (Harrison, 1978: 553). Situations at the Organizational Level are very dynamic with the decision focus changing often. The decision making environment is most complex at this level.

Managerial Level. The Managerial Level is the level at which the Program Manager works. Most resources employed at this level are either under the PM's direct control or are intended to support the program via an organizational matrix or some other like device. Figure 15 illustrates the Managerial Level. It incorporates the five-step baseline decision analysis cycle.

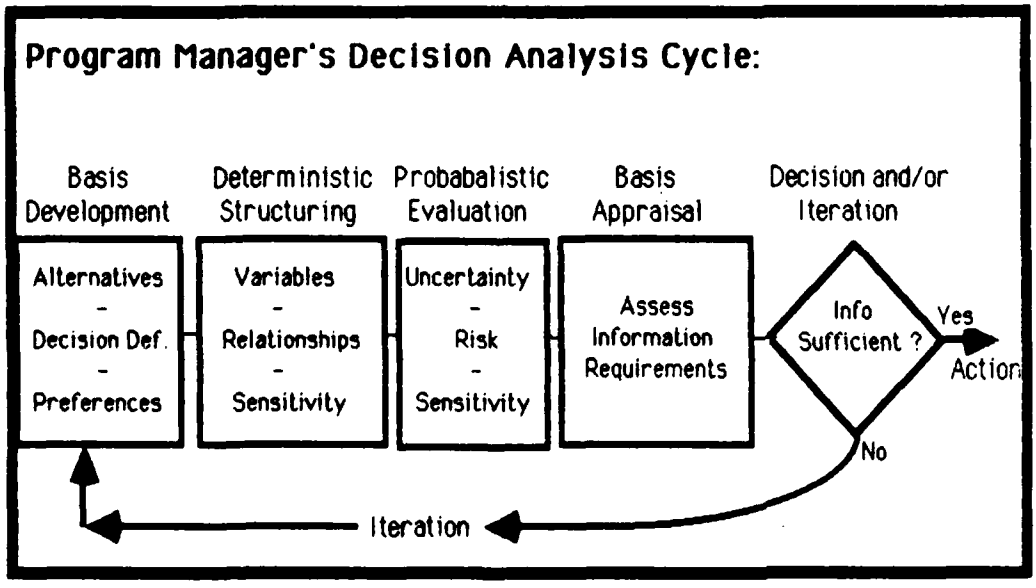

Figure 15

Managerial Level

The decision analysis cycle constitutes the primary tool available to the PM to organize data and solve the problem. The PM will take from the macro-level data necessary to proceed with the decision making process. Such data includes directives concerning organizational preferences (e.g. Program Management Directives and Statement of Operational Need), procedural guidelines concerning how the answer must be formulated (e.g. POM submission instructions), coordination required, and usually a scheduled deadline for completion.

Supporting Level. This level is analogous to office instructions that detail how internal organizational processes are to work. For example, an office instruction may define what types of information may be sent to higher headquarters, under whose signature, and under what circumstances. In Program Offices organized around a matrix, instructions may exist that define how individual projects under the control of the PM are to be handled in terms of management team make-up, contract change review procedures, etc. Figure 16 illustrates the supporting level.

The supporting level also acknowledges the fact that the PM is not only a manager of programs but is also a leader of a team of individuals. As the military becomes more technologically oriented with increased reliance on technical expertise, and as functional staff specialization increases, the military manager must rely more and more on influence in lieu of simple coercion via the hierarchical authority of position within the organization. This implies the use of indirect techniques of influencing an individual's behavior such as

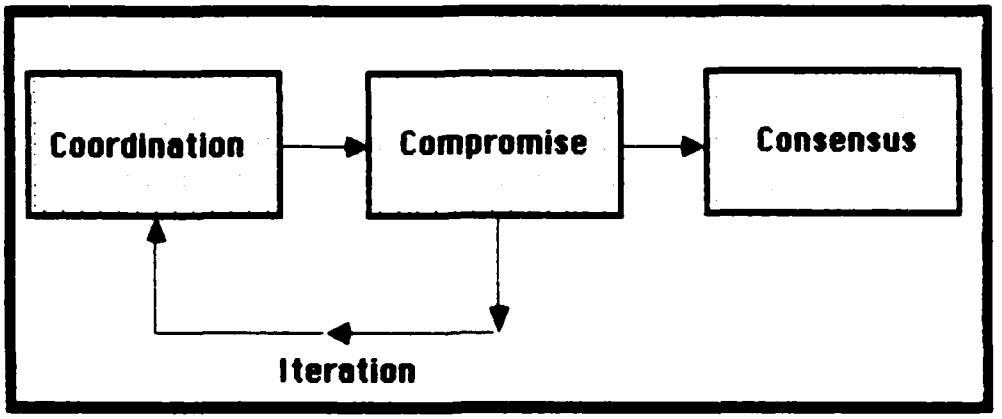

Figure 16

Supporting Level

group persuasion and an emphasis on group goals (Harrison, 1978: 578). As a leader, the PM must ensure that the Program Office understands and supports the decision to be implemented. To accomplish that, the PM must use coordination and compromise in order to achieve consensus.

System Structure. The structure of ODAM must account for the complexity of the interface between the four acquisition sub-processes and the iterative nature of decision making situations and the problem-solving activities undertaken to resolve them. The ODAM is discussed below in terms of inputs, process, and outputs.

Inputs. The decision analysis cycle's most significant possible contribution is its ability to generate quality information that can be brought to bear on complex problems in an uncertain world. The cycle forces the organization to explicitly deal with the following:

1. Definition of the problem,

2. Determination of desired outcomes,

3. Generation of possible alternative course of actions that might lead to those outcomes,

4. Estimation of the values the organization places upon each of those outcomes,

5. Assessment of the organization's utility function, and

6. Assessment of the environmental uncertainties surrounding the decision.

The challenge facing the organization is to ensure that its structure and managerial processes provide the raw material necessary to allow the decision analysis cycle to work. This is especially true when determining values and utilities. Decision analysis theory offers several techniques for assessing the utilities of individuals, but cannot do the same for organizational groups.

All large organizations create plans of one kind or another. Plans that lay out strategic intentions for the organization are likely candidates for providing utility and value information. The organization that accepts decision analysis and implements the ODAM, would be required to consider these requirements and possibly modifying its procedures for preparation of planning documents to ensure that specific statements regarding utility and value would be included.

While the quality of these planning statements may lag in the early stages of the implementation, as the ODAM framework matures within the organization and individual participating managers become more familiar with its usage, their experience will

enrich its application. As time progresses, the requirements of the decision analysis process will likely creep into many facets of the organization's ongoing operations. Ultimately, the Program Manager or analyst using ODAM should encounter few significant deficiencies in the information available.

Process. The ODAM process builds upon the Japanese 'decision making' approach discussed by Drucker (1974: 470). Drucker summarizes that approach as:

1. Focusing on what the decision is all about,

2. Bringing out dissenting opinions,

3. Focusing on alternatives rather than the 'right solution', and

4. Implementing the decision after consensus is reached ('selling' the decision thus being unnecessary).

In ODAM, this translates to an institutionalization of a process of complete and thorough coordination throughout the organization. The first purpose of the coordination is to bring out a range of opinions from different segments of the organization, thus enriching the information available to the decision makers. The second purpose of the coordination process is to promulgate a meaningful compromise among the various elements within the organization having a stake in the decision. The result of the coordination process, after the compromise stage, is an organizational consensus about the nature of the problem and the decision to be made, the alternatives available for action, how the alternatives are evaluated,

and the resulting conclusions with regards to the optimum, or most satisfactory, alternative.

Outputs. Both Drucker and Woolsey emphasize that a decision is meaningless if it is not, or cannot, be implemented. Therefore, the output portion of ODAM addresses the need for the organization to ensure the 'do-ability' of the course of action decided upon.

The process portion of the ODAM, while enhancing the organization's ability to deal with the political arena, does not guarantee success. Concise documentation of the decision making process, from its genesis to conclusion, should be available during and after the process. Such documentation should facilitate communication during the coordination activities and provide for control of the implemented action (Raiffa, 1968: 269).

The result of concise documentation and effective control will then be the best opportunity for successful implementation of the organization's chosen course of action.

Evaluation

The ODAM outlined above must be 'operationalized' in the context of unique organizational settings - for instance the Air Force acquisition management process. Its overall prescriptions and its structured framework must be reflected in organizational issues ranging from organizational design to the use of consultants. All

these aspects must be dealt with and resolved prior to exercising the ODAM if satisfactory results are to be obtained.

The organization must be designed to complement the coordination activities dictated by the model. The organizational structure and definition of responsibilities must be aligned in a manner consistent with the desire to reach consensus through compromise. Likewise, without efficient communication channels within the organization, to all parts of the organization, effective coordination will not be possible. If an organization lacks these characteristics, the effort of implementing ODAM will result in frustration and probably failure.

All organizations create information. To effectively implement the ODAM, the formal procedures for preparing organizational plans must look forward to the fact that those plans might someday be required to support the requirements of decision analysis activities. Specifically, the plans must include reference to the relative values the organization assigns to various future conditions - both in its own situation and the state of the external environment. Management information systems (MIS) must also be designed to provide all the information possible to support future decision analysis exercises. MIS output can prove beneficial when defining alternatives, assessing uncertainties, and supporting valuations.

The ODAM will be used by people - in this study the acquisition Program Manager and the program management team has been the focus of the discussions. The requirements of the model should influence both job definition and personnel placement. Any tool, no

matter how inherently effective, cannot succeed if employed by misplaced or under-trained personnel.

Summary

The Organizational Decision Analysis Model, summarized in Figure 17, offers the opportunity to implement into the Air Force acquisition process a rational and coherent decision making framework for use by the acquisition Program Manager. While based upon a process that is inherently not intended for organizational implementation, the ODAM makes allowances for the relevant differences in the decision making situation so that the benefits of rational, consistent and defensible decision making remain intact.

From the perspective of the Program Manager, the decision analysis cycle in ODAM's managerial level provides the necessary structure to information gathering activities that can be lacking when attempting to manage problems that may extend over several acquisition system sub-processes. Similarly, the supporting level addresses the need for the PM to get an organizational consensus from within the decision making unit about the many inputs to the decision analysis cycle. It is the supporting level that builds the foundation for the Program Manager to eventually acquire a consensus from the organizational as a whole at the organizational level. The organizational level itself highlights for the PM critical considerations with respect to the environment and systemic inputs

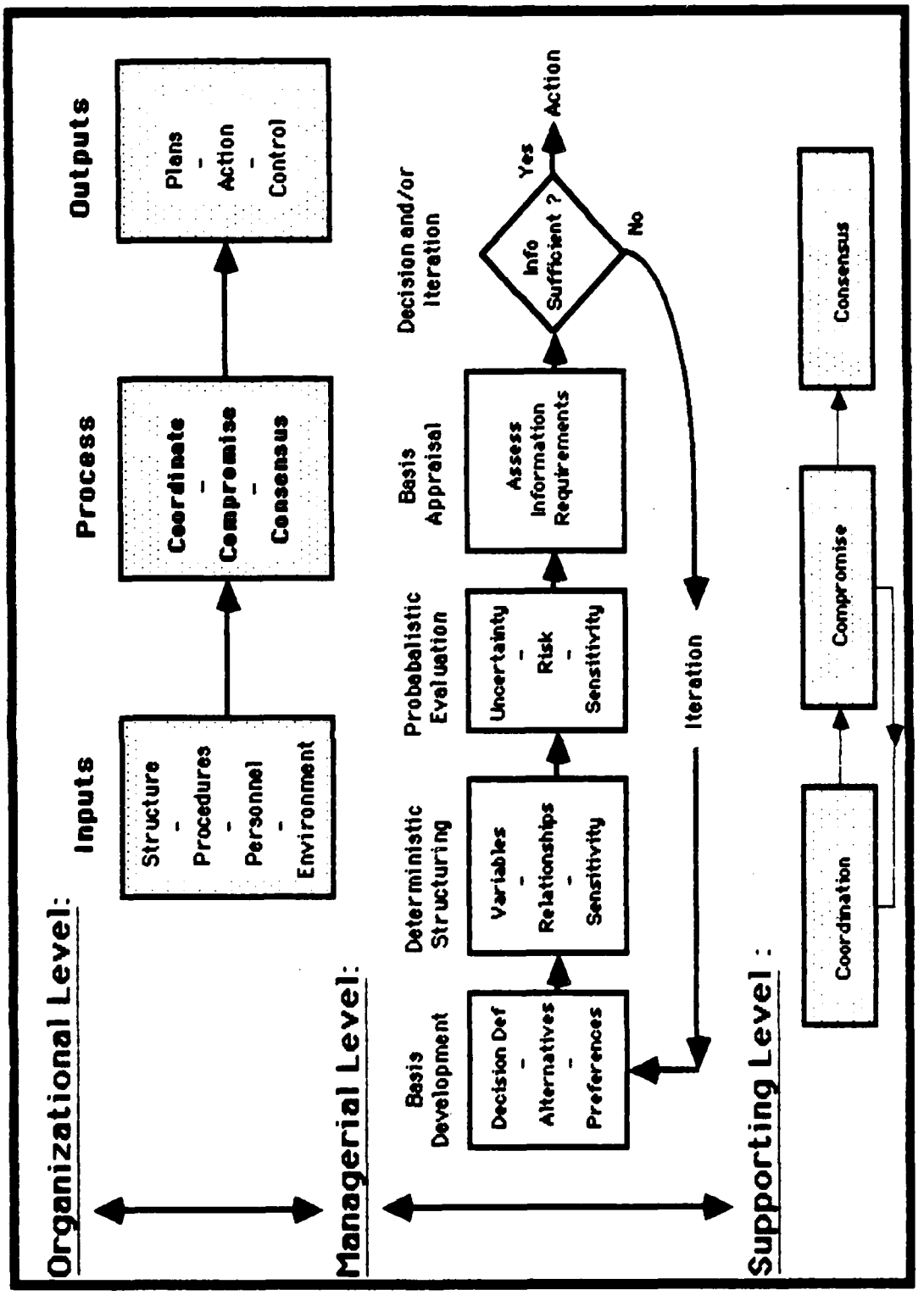

Figure 17

The Organizational Decision Analysis Model

and output requirements that may be outside the PM's immediate ability to control. ODAM is a framework for consistent, explicit and effective management decision making by the acquisition Program Manager.

Next, Chapter V will analyze the Air Defense Fighter Competition by comparing that recent acquisition decision to the ODAM. The analysis will proceed as described in Chapter III. The results of the study will be summarized in Chapter VI and conclusions drawn.

V. Comparative Analysis

Introduction

The purpose of this chapter is to analyze the acquisition Program Manager's decision support documentation used during the Air Defense Fighter (ADF) Competition. This documentation was reviewed as described in Chapter III and the major events during the decision making process are highlighted. Next, the documentation was categorized and compared to the Organizational Decision Analysis Model (ODAM) developed in Chapter IV. The results of the categorization were then analyzed for evidence that the ODAM might be appropriate for use in the DOD Weapon System Acquisition (WSA) process and that the primary WSA sub-processes could support the needs of the decision analysis methodology. As described in Chapter III, the comparative analysis focused on information sources, communications channels and management actions during the ADF decision process as documented by the program management team.

Historical Overview

As discussed in the literature review, several changes and events affecting the WSA process had occurred during the middle 1980's. These changes were the passage of the Competition in Contracting Act (CICA) of 1984, the Goldwater-Nichols DOD Reorganization Act of 1986, the Graham-Rudman-Hollings Balanced Budget and Emergency Deficit Control Act and the publication of the

report of the President's Blue Ribbon Panel on Defense Management. These changes and events contributed to a situation that required a series of acquisition decisions on the part of Air Force management. There was a prevailing sense that DOD acquisition management was inefficient and that competition in contracting was a cure for that problem. At the same time, there was considerable pressure to reduce the DOD budget.

On 2 April 1985, Thomas V. Jones, Chairman of the Board and Chief Executive Officer of Northrup Corporation, sent a letter to Secretary of the Air Force Verne Orr and Air Force Chief of Staff Charles A. Gabriel (Jones, 1985). This letter was an unsolicited proposal to develop and sell to the Air Force 396 F-20 fighter aircraft.

This letter initiated the first of three phases of Air Force activity to arrive at a resolution to the problem posed by Northrup's unsolicited proposal (i.e. what action should the Air Force take with respect to the F-20). In the first phase, the Air Force was required to respond to the Northrup proposal. The purpose of the response was to notify Northrup whether the Air Force had decided to accept the proposal.

The letter outlined a proposal to deliver 396 F-20 aircraft in a four-year fixed price multi-year procurement, with a Fiscal Year (FY) 1986 unit procurement price of $15.0 million (then year dollars). The first USAF F-20 was to be delivered 24 months from go-ahead and the final aircraft in FY91. The follow-on support was guaranteed at a fixed price of $475 per flying hour (FY85 dollars).

The proposal letter mentioned that Northrup's F-20 development was originally intended to meet the "Government's expressed need for a modern fighter that could help friendly nations achieve the maximum level of national security without overtaxing their resources" (Jones, 1985). The original intent of the F-20 program was to meet a Carter administration effort (circa 1978) to produce an inexpensive lightweight fighter to support Foreign Military Sales (FMS). The Reagan administration reversed this policy in 1982 when it began selling F-16 and F-15 aircraft under FMS guidelines. When no sales were realized after five years of development and two of three F-20 prototypes crashed, Northrup changed its marketing approach. Northrup's proposal to the Air Force was coordinated with an attempt to influence the Reagan administration and the Congress that the U. S. Air Force, originally an unintended client, should buy the plane. The plane was being "...equated with the virtues of competition" (Gordon, 1985: 1608). Northrup's approach appeared rational given the recent passage of the CICA and the threat of Graham-Rudman deficit control budget cuts.

CEO Jones stated in his letter of 2 April 1985 that:

> ...the Air Force now [had] the opportunity for an F-20/F-16 complementary force, acquired and apportioned with the benefit of competition, that will reduce procurement and operating costs and give the Air Force more flexibility in managing the size and mix of its fighter force within current and projected budget constraints (Jones, 1985).

The proposal went on to stress the cost advantages of the F-20 as compared to the F-16 while pointing out the relative performance strengths of the F-20 for certain missions. The continental U.S. air defense role was one of these missions.

A Northrup proprietary Proposal Summary, attached to the letter, included a comparison of F-20 force effectiveness compared to the F-16. The proposal emphasized logistical measures of effectiveness. The ultimate measure of effectiveness was described as capability when operating as a force. The proposal listed contributing factors as high reliability, low maintenance, low mean time to repair and quick turnaround times.

A second proprietary attachment was titled Program Acquisition. This document was a very brief review of the price basis of Northrup's proposal (weapon system acquisition proposals are usually cost based). The document covered the multi-year procurement quantities, aircraft flyaway prices, initial support prices with conditions and assumptions, an economic price adjustment clause, progress payment provision requirements, Northrup's follow-on support guarantee, warranty and performance guarantees, and a program cancellation provision. Specific details of these two documents cannot be included here because of their proprietary nature.

Within the Aeronautical Systems Division (ASD), responsibility for the proposal evaluation was assigned to the Deputy Commander for Tactical Systems (ASD/TA). Responsibility was further delegated to ASD/TAA, the Fighter/Attack System Program Office (SPO). The

Vice Commander (ASD/CV) was made the executive point of contact within ASD.

On 2 May 1985, ASD/CV signed a letter to the Deputy Chief of Staff (DCS) for Systems at the Headquarters of Air Force Systems Command (AFSC/SD) transmitting the completed evaluation of the Northrup unsolicited proposal. The evaluation addressed the following points which are relevant to acquisition decision making.

> 1. Without a stated user requirement, the SON from the requirements sub-process, evaluation of the Northrup proposed configuration was not possible.
>
> 2. The proposal did not comply with Federal Acquisition Regulation (FAR) requirements as defined in the contracting sub-process.
>
> 3. The proposal did not include guarantees for performance, reliability, maintainability, availability, or required modifications which were important considerations during the acquisition management sub-process.

Along with the evaluation report was a proposed letter to Northrup stating that while the Air Force was pleased to receive the unsolicited proposal, it could not be accepted because of the deviations from the FAR and other regulations. Also, the letter stated that the proposal lacked Air Force approved specifications and a complete test plan.

At this time program management documentation changed its focus and the second phase of activity began. Almost from the beginning, concerns arising from the Northrup unsolicited proposal took a broader perspective than the evaluation and response in the 2

May 1985 Air Force response to Northrup. The issue was generally seen in the context of overall tactical aircraft competition and the possible effects of competition on force structure. The second phase involved activities directed toward a 'limited competition' in which the F-20 would be one of the competitors.. At this point, the key players constituted ASD/CV, ASD/TA and staff, ASD/CC (the Commander) and his Chief of Staff (CS), AFSC/SD, ASD/YZ (the Deputy Commander for Propulsion), and ASD/PM (the Deputy Commander for Procurement). As early as 15 April 1985, the following issues were discussed at HQ AFSC: (1) the strong possibility that the F-20 procurement would be added to the FY87 Program Objective Memorandum (POM) and (2) that the Air Force would push for a "head-to-head competition" between the F-16 and the F-20. By 15 May 1985, meetings at HQ AFSC and the Air Staff with representatives from ASD were held to discuss possible Air Force strategies for the competitive procurement of tactical fighters.

On 22 August 1985 a memo was sent to ASD/CC proposing an F-20 Program Plan in response to direction received in an ASD/CC memo of 27 July 1985 to begin such planning . The program plan is the first documented example of ASD assuming the role of 'problem solver' and formulating a definite approach. The plan consisted of F-20 POM cost information, F-20 schedules, a competition evaluation plan and schedule for the Air Defense competition (AD-X), F-20 SPO approved schedule and costs estimates, and a review of FAR waivers and deviations.

The proposed F-20 Program Plan was the culmination of the second phase of Air Force activity. Notable in the plan, in terms of organizational decision making, was an alternative approach to the Air Defense Fighter competition based upon the Dual Role Fighter (DRF) Competition of 1984 (F-16F versus the F-15E). The action plan described the proposed organization of the evaluation team, stated how evaluation methodology was to be determined, described how the evaluation plan should be developed, and stated how the evaluation should be implemented. Preliminary schedule projections were also made. These reflected dates for the receipt of direction, the release of a Request for Proposal (RFP), the subsequent receipt of contractor proposals, the formal evaluation of those contractor proposals, the conduct of Operational Test & Evaluation (OT&E), final decision and the award of a contract.

Little came of this early effort to narrow the programmatic options. More and more the organization's concerns focused on how to comply with Congressional direction to proceed with a tactical fighter competition in FY 86 while also complying with other existing laws and regulations. Schedule was the primary constraint identified. The chief components of that constraint were F-20 Development Test & Evaluation (DT&E) and IOT&E requirements, and the many FAR deviations and waivers necessary to meet the early contract award date proposed by Northrup and alluded to by Congress.

On September 9, 1985, ASD/CC sent a message to the Commander of Systems Command (AFSC/CC) identifying several concerns. He stated that

> ... while there is lots of talk about introducing the F-20 aircraft into the USAF inventory, **there doesn't seem to be any formal, structured dialog on the subject**. It concerns me that such a setting is a great one for getting the wrong decisions made... frustrating as our normal process can be, it at least has a formal process within which these basic program decisions are made (McMullen, 1985) [Emphasis added].

Discussions about how to structure a competition similar to the DRF lasted only briefly. In response to a 22 August 1985 Program Decision Memorandum (PDM) from the Deputy Secretary of Defense (DEPSECDEF), a full and open competition for an Air Defense fighter replaced the 'DRF-like comparison' between the F-16 and F-20. This action initiated the third phase of activity.

In a 16 September 1985 memorandum to the DEPSECDEF, the Secretary of the Air Force outlined the Air Force "... plan to proceed with an unrestricted competition for an Air Defense aircraft" (Orr, 1985). A point paper attached to that memorandum noted that this action was consistent with the 22 August 1985 Program Decision Memorandum (PDM) and would use full source selection procedures required by AFR 70-15, Source Selection Procedures. The point paper also stated that Air Force efforts would be focused upon developing a Request for Proposal (RFP), a Source Selection Plan (SSP), and other procurement related documents. The proposed schedule of events leading to contract award was listed as:

1. RFP release - January 1986,
2. Contractor responses due - March 1986,
3. Evaluation complete - July 1986,
4. Contract Award - October 1986.

Activity after mid-September was almost totally directed toward three ends. First, a Program Management Directive (PMD) was required before the RFP could be released to potential sources. The final PMD (Number PMD 5268/27139F) was signed by AF/RDQ and issued to the Major Commands on 21 November 1985. The Executive Summary of the PMD stated that

> ... this Program Management Directive (PMD) provides direction for the full scale development, procurement, and support of Air Defense (AD) aircraft. The aircraft will be used primarily for Strategic Air Defense of the continental United States (DAF, 1985c).

The PMD also referenced the Tactical Air Forces (TAF) Statement of Operational Need (SON) applicable to this program. However, the SON at this time was still in the validation process and was listed as "for comment" only. The TAF SON (Number 310-85) was validated on 7 January 1986. The SON was critical to the contracting approach since a System Requirements Document (SRD) was to be issued with the RFP instead of a system/item specification. The SRD would be based upon the requirements stated in the validated SON.

After issuing a draft RFP to industry and interested government organizations, the final ADF RFP was issued on 24 March 1986. The RFP was sent to McDonnell Douglas Corporation,

Boeing Military Airplane Company, General Dynamics Corporation, and Northrup Corporation. Proposals were due to the Air Force for evaluation by 9 May 1986. This allowed only 45 days for the contractors to prepare their proposals. Normally, contractors are allowed 60 days. The accelerated schedule was an indication of the Air Force attempt to meet the Congressionally mandated timetable for a decision.

The prioritized areas of evaluation were (in descending order of importance) Mission Effectiveness, Technical, Life Cycle Cost, and Logistics/Management. The contractors' proposals were to be assessed using the following criteria (each ranked equally): soundness of approach, understanding the requirements, compliance with requirements, and past performance (ASD, 1986: Section M).

Ultimately, only General Dynamics and Northrup submitted proposals. Northrup submitted a proposal for its F-20. General Dynamics submitted two proposals. One proposal was for an F-16SC and the other was for a retrofit program to modify existing F-16A/B aircraft. The proposed F-16SC (Specially Configured) was essentially an F-16C without the high cost avionics and radar capabilities necessary for a front-line tactical multi-role aircraft. The changes proposed by General Dynamics as part of their F-16SC proposal were intended to place it in better price competition with the F-20 and to acknowledge that the requirements of the AD mission were less rigorous than other tactical missions (e.g. close air support, defensive counter air, etc.) to which the F-16 was assigned.

On 31 October 1986, the Secretary of the Air Force held a press conference at which time he announced the winner of the ADF Competition. The winner was the General Dynamics proposal to modify existing F-16A/B aircraft.

Analysis of Selected Decision Support Documentation

As described in Chapter III, the program management documents assembled by the Program Manager of the ADF Competition were categorized in accordance with the content analysis plan. The plan was to compare subcategories (variables) most relevant to organizational decision making. The data generated by the content analysis were then statistically analyzed to determine if any correlation existed between pairs of subcategories. As discussed in Chapter III, the indicator chosen for possible correlation was the contingency coefficient. The results of the analysis are summarized below.

The ADF Competition was initiated on 2 April 1985 by the receipt of the unsolicited proposal from Northrup and the last decision was finalized on 31 October 1986 when General Dynamics was announced as the winner of the competition. The frequency distribution of documents over that time period followed a pattern which peaked mid-way through the cycle with much less activity at both the beginning and end. The vast majority of documented activity (58.8%) occurred during the three month time period from October until December 1985. This coincides with the efforts of the

Air Force to issue the PMD (21 November 1985) for the Air Defense Fighter program as well as to validate the Strategic Air Defense TAF SON (7 January 1986). From January thru March, activity abated in frequency but was still important because the efforts of the ADF program management team were now directed primarily at the single task of issuing the RFP.

In the time period following the RFP release in March 1986, documentation was even less frequent. Only 9.55% of all documents fell within the seven month period from April through October 1986. For most of this period, the program management team was involved in source selection tasks, which are treated as sensitive and not the subject of communication activity. After the contractor proposals were received on 9 May 86, documentation was relatively infrequent thru the end of October 1986 at which point the documentation effort ceased.

During the entire time period covered by the documentation, each document was categorized as to its flow within or between organizations. Most documents were either transmitted within the organization (Internal: 31.66%) or were received by the organization from some other originating office (Incoming: 31.66%). Referring to Figure 12 in Chapter IV, the organization's boundaries were shown to be the primary organizational elements involved in the ADF source selection. Documents sent out of the organization accounted for 13.9% and documents in the NA category (e.g. magazine articles, etc.) accounted for 22.01%. Only two documents, or .77% were of unknown origin. The contingency coefficient for the comparison of document

flow versus time was .547. The p-value was .0023 which, at a .05 level of confidence, indicates that the flow of documents was correlated to the time period within the decision process. In other words, the make-up of each individual flow category was dependent upon the month during the cycle in a manner dissimilar to the overall frequency of documents over time. Therefore, the level of individual document flow directions can be identified more with one period than another. Depending on the month during the cycle, the Program Manager would have been relying on different communication (i.e. internal or outgoing) channels to meet management objectives.

The breakdown of the documents by the problem solving steps is discussed next. The problem definition step accounted for 16.03% of the documents. Alternatives identification and gathering data totalled 16.41% and 44.27% respectively. Evaluation accounted for 16.41% while decision related documents were only 3.82% of the total. The data gathering step was the most frequent activity by a factor of almost three. As mentioned before, while the volume of decision related documents was low, their importance to the progress of the overall acquisition process and its ultimate success was critical.

The results of the contingency table analysis comparing the problem solving steps versus time is shown in Table 2.

While only the problem definition step was determined to be related to time at a confidence level of .05 (p-value = .0001), the data gathering step was close with a p-value of .054. Also, both the identification of alternatives step and the evaluation step had

Table 2

Contingency Coefficient/p-value: Time vs. Problem Solving Steps

Step	
Problem Definition	**.432/.0001**
ID Alternatives	.308/.0702
Gather Data	.314/.0540
Evaluation	.308/.0702
Decision	.255/.4385

BOLDFACE: Statistically significant at .05

p-values of .0702. Only the decision step was found to exhibit little relationship. Its p-value was .4385. Therefore, the problem solving step documents were dependent on the time of the cycle. The observed frequency table data substantiates this. During the October 1985 through January 1986 period, 54.76% of the problem definition documents were generated. Another 19.05% were generated in April 1985 and 16.67% in September 1985. In the period from February through October 1986, no problem definition documents were generated. Therefore, the generation of problem definition related documentation closely followed the timing of the major documents in the decision making process: receipt of the unsolicited proposal in April 1985, the work to issue the PMD (November 1986) and to validate the SON (January 1986), and the effort to prepare an issue the draft RFP (January 1986). This statistically significant relationship is exactly what would be expected to occur.

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The documents were also organized according to the acquisition sub-process they were associated with. Considering all documents, the requirements sub-process accounted for 10.31% and the budget sub-process was 8.02% of the total. The acquisition management sub-process was much more frequent at 44.27% while the contracting sub-processes, at 50.0%, was the most frequent (Note: the percentages need not total to 100% since a single document might support more than one sub-process). Table 3 shows the resulting contingency table analysis of the four sub-processes versus time.

The contingency coefficient for the requirements sub-process indicated that it was not significantly related to the distribution of

Table 3

Contingency Coefficient/p-value: Sub-Processes vs. Time

Requirements	Budget	Acq Mgt	Contracting
.286/.1801*	**.341/.0108**	**.483/.0001**	**.363/.0023**

BOLDFACE: Statistically significant at .05

*: Invalid test due to expected frequencies < 1

documents over time. This result was not expected since it implies that the requirements sub-process was not more prevalent in the early months of the decision making process as would normally be the case. This is especially so since it was shown earlier that problem definition documents were found to be related to time and they are analogous to defining requirements. Based on the detailed observed frequency tables, the 10.31% of all documents relating to the requirements process were all observed prior to February 1986. The interest and concern of the managers toward the PMD and SON was evident but, once the organization had documented its requirements, that documented concern vanished. Also, once the requirements were reflected in the SRD and the RFP, continued reference to these documents was not necessary (disregarding any possible updates). Inferences based upon the data in the later months, however, must be questioned since in the period from April to October 1986 all cells exhibit an expected frequency of less than 1.0. Thus, although not

statistically significant, as expected, the requirements documents do occur in the appropriate time frame.

Each of the other three sub-processes were related to time. It was expected that the acquisition management sub-process would be related to time, mirroring the initial activity in April 1985, the peak at the end of calender year 1985 coinciding with the PMD, and the lull after March 1986 when source selection activity became dominant.

Likewise, the contracting sub-process would be assumed to be related to time for similar reasons. The unsolicited proposal in April 1985 was also a contracting action. Activities in the period from October through December 1985 were focused on the preparation of the draft RFP to be released in January 1986. After the RFP was finally released on 24 March 1986 and the source selection began on 9 May 1986, contracting related documents would become less visible.

The budget sub-process was not expected to be related to time. The ADF program management documentation does not show evidence that the management team was actively involved in the POM process. In fact, most budget related documentation was information provided to the PM to facilitate program planning. It must be assumed, therefore, that budget was related to time, not because of the ADF Competition schedule of events but instead, because of the overall PPBS schedule of events in the Air Force as well as in the Congress.

The final comparison focusing on time was with the three communications tasks: information search, intra-organizational

coordination, and extra-organizational communication. Table 4 summarizes the results of the contingency table analysis.

Table 4

Contingency Coefficient/p-value: Communication Tasks vs. Time

Information Search	Intra-Org. Coordination	Extra-Org. Coordination
.253/.4570	**.386/.0003**	**.355/.0042**

BOLDFACE: Statistically significant at .05

Both of the coordination activities, within the organization and outside the organization, were found to be related to time. As above, 75.35% of the intra-organizational coordination came in the three month period from October to December 1985 and 6.85% came in the early phase of April and May 1985. No intra-organizational coordination documents were found in the months after June 1986. Again, intra-organizational coordination appeared linked to the major decision documents of the unsolicited proposal evaluation, the PMD, the SON, and the RFP.

Extra-organizational coordination had a distribution similar to the intra-organizational. In the October to December 1985 time period, 56.76% of the external coordination seeking documents were found. It was different from intra-organizational coordination, however, in that extra-organizational coordination was skewed away from the early months of the decision process toward the latter.

External coordination did not really begin until September 1985, after the PDM was issued. Prior to that time, it appears that program management approached the ADF issue as essentially an internal problem and that any request for outside assistance and support was premature.

Information search, however, was found to be not related with time. While information search exhibited the same mid-cycle peak as above (68.3% in October thru December 1985), it was also broader in scope, extending from September 1985 to March 1986. There were no information search documents after March 1986. Information search was then a broader subcategory than the two coordination activities. The information search documents in the early phase (April to May 1985) coincide with the intra-organizational coordination associated with the evaluation of the unsolicited proposal. The information search documents coming in the period from January thru March 1986, however, coincide with the extra-organizational coordination associated with the final preparation of the RFP. Overall, information search documents followed the general frequency trend of all the documents. Information search shared the mid-period peak with the other two communication processes. However, information search documents in the early phase were primarily searching internally while in the latter phase they were searching externally.

The preceding analysis of the subcategory time (Tables 2-4) revealed the following about the ADF Competition decision making process. First, although problem definition documents were

significantly correlated with time and were shown to be frequent early in the process as would be expected, the frequency of the documents supporting the requirements sub-process were shown to be independent of time. Since normal acquisition procedures dictate that the SON be validated before other acquisition management actions occur (e.g. enter a new program into the POM, issue of new PMD, etc.), the fact that this effort was initiated by an unsolicited proposal and accelerated by the Congressionally directed schedule probably accounts for the majority of this result. Also, documents were described as problem solving that did not support the requirements sub-process. There were also problem solving documents in the acquisition management and contracting sub-processes as well.

The levels of document flow direction were also found to be significantly related to time. Internal documents, for instance, tended to be more frequent in some months than others. Similarly, intra-organizational coordination was also found to be significantly related to time. These results underscore the importance of gaining an internal organizational consensus. Thus, the data support the proposition that in the WSA process, individual decision makers, as defined by Howard, are the exception and not the rule. The complexity of the programs under study necessitate elaborate coordination review cycles of information products. The observed frequency tables show this to be particularly so in the unsolicited proposal evaluation phase and in the three month peak period just before the draft RFP release.

Extra-organizational coordination was also related with time, but differed from intra-organizational coordination in that its observed frequency continued after the October to December 1985 peak and lasted until March 1986. Also, there was little external coordination during the unsolicited proposal phase.

By taking both extra-organizational and intra-organizational coordination as different subsets of information search activity, the lack of correlation between time and the information search activity can be partially explained. In addition, it was originally expected that the information search subcategory would have behaved the same as the gather data subcategory discussed above in Table 2. Both of these similar subcategories were not found to be related to time. Therefore, it appears that in the ADF Competition case, the Program Manager desired a comparable level of information search throughout the process.

Returning to document flow, Table 5 shows the results of flow versus the four acquisition sub-processes. The acquisition management and contracting sub-processes were both determined to be significantly related to the direction of document flow. The contracting sub-process had a p-value of .0005 while acquisition management had a p-value of .0027. Both the requirements and budget sub-processes were very weakly related, with p-values of .6083 and .6645 respectively.

Most requirements related documents were either incoming (44.44%) or internal (29.63%). Since it has already been discussed in relation to Table 3 that requirements documents seemed to cluster

Table 5

Contingency Coefficient/p-value: Sub-Processes vs. Document Flow

Requirements	Budget	Acq Mgt	Contracting
.102/.6083	.096/.6645	**.243/.0027**	**.267/.0005**

BOLDFACE: Statistically significant at .05

around the key decision activities in April 1985 and November 1985 to January 1986, this result should be expected. Incoming documents were required to deal with the formulation of the unsolicited proposal evaluation and for the timely preparation of the draft RFP which had to be distributed in January 1986 to meet the Congressional schedule. Similarly, intra-organizational coordination was heavily concentrated in November and December 1985, the same time the draft RFP was being prepared.

That fact that the requirements sub-process was not related to flow was not expected. As discussed in the first section of this chapter, the ADF Program Manager was not a key player in the requirements sub-process. Therefore, incoming or not applicable documents were expected to dominate the activity in this sub-process. That this was not the case, indicates that program managers can play an important information transfer role in the requirements process and that, perhaps in this case study, requirements related documentation was driven by forces outside of the requirements sub-process itself.

For the budget sub-process, most documents (35.0%) were in the NA (Not Applicable) flow category. This was probably due to the fact that most budget documentation was obtained by the program management team as information copies of documents that were not, per se, meant for them directly, but which contained funding information necessary for effective acquisition planning. The budget documentation was expected to be independent of the direction of flow, and apparently was.

Most acquisition management sub-process documents were internal (38.26%) followed closely by incoming (37.39%). Only 12.17% of the acquisition management documents were categorized as outgoing. Since the contracting sub-process was also found significantly related to flow, it is necessary to address that sub-process along with the acquisition management sub-process. Internal documents were the most frequent in the contracting sub-process (36.43%) followed by incoming documents (27.91%). The outgoing sub-category was larger for contracting at 20.16%. Given the nature of this decision (i.e. considerable contracting involvement), the amount of outgoing documentation appeared reasonable.

Much of the coordination with outside organizations was categorized as part of the contracting sub-process. This was also seen in the analysis of the observed frequency tables for those two sub-processes. The peak for the acquisition management documentation was in October 1985 before the 21 November 1985 signing of the ADF PMD. The peak for the contracting documentation, however, came

two months later in December 1985, just before the release of the draft RFP.

In summary, the Program Manager had a greater degree of involvement in the acquisition management and contracting sub-processes than the other two. That in turn affected the timing and high level of internal coordination carried out. Also, ADF program management displayed the need to coordinate information internally while also receiving from other external organizations the information needed to accomplish its decision making task. This finding substantiates the need for the Supporting Level of the ODAM and supports the need for the Organizational Level interface.

Table 6 summarizes the comparison results of the three communication tasks versus document flow. In all three cases the relationship was shown to be significant. While the contingency coefficient of intra-organization coordination was the largest, all three had p-values of .0001. Therefore, the distribution of communication activity depended upon the directional flow of documents relative to the ADF program management team.

The results reflected in Table 6 were expected. Internal and outgoing documents made up 48.78% and 36.59% respectively (85.37% total) of the information search documentation. Search initiating activity more likely focused on functional areas within the organization and other interested external organizations. Intra-organizational coordination accounted for 73.17% of the internal documentation. Thus, the primary purpose of distributing information within the organization was to gain consensus.

Table 6

Contingency Coefficient/p-value: Communication Tasks vs. Document Flow

Information Search	Intra-Org. Coordination	Extra-Org. Coordination
.365/.0001	**.574/.0001**	**.518/.0001**

BOLDFACE: Statistically significant at .05

Extra-organizational coordination was dominated by incoming documents (52.05%) and outgoing documents (38.36%). The fact that extra-organizational coordination documents were mostly incoming, indicated that many external organizations were seeking coordination from the ADF Program Manager. As discussed below, however, there was no relationship between any of the sub-processes and extra-organizational coordination. Therefore, while the statistical significance of incoming extra-organizational coordination was not expected, there is not an indication that any one sub-process drove this result.

To complete the current discussion of document flow, Table 7 shows the results of the contingency table analysis of flow versus the five problem solving steps. Gathering data was the most strongly related to the flow (p-value: .0008) while both the identification of alternatives and evaluation steps were also significantly related with a p-value of .0022. Neither the problem definition nor decision steps were shown to be related to flow.

Table 7

Contingency Coefficient/p-value: Document Flow vs. Problem Solving Steps

Step	
Problem Definition	.100/.6249
ID Alternatives	**.246/.0022**
Gather Data	**.261/.0008**
Evaluation	**.246/.0022**
Decision	.169/.1061

BOLDFACE: Statistically significant at .05

Data gathering activity was the most frequent of the problem solving step overall (44.4%) and the most prevalent in each of the four document flow categories. The largest single value for any cell of the document flow versus problem solving step matrix was for incoming documents supporting data gathering activity (45.22%). This shows that a primary objective of the program management team was to gather information from outside organizations. Internal documents accounted for 29.96% of the data gathering documents.

The decision step was the least frequent problem solving step with only 3.86%. Most of the decision documents were either incoming (40.0%) or outgoing (40.0%). As a percentage of all documents, the outgoing flow category was more frequent. This is reasonable given the involvement of the management team in the contracting sub-process and the need to inform other organizations of the evolving nature of the RFP.

Alternative identification document frequency (16.6%) was mostly the result of internal (37.21%) communication. Problem definition (15.83%) was limited primarily to incoming (34.15%) and internal (39.02%) communications. Evaluative documents were found mostly in internal documents (37.21%) although both incoming (27.91%) and outgoing (27.91%) also played a large role. These results imply that, as expected, much of the detailed alternative identification and evaluation work in the ADF Competition was managed relatively closely by the ADF Program Manager

The results in Table 7 again point to the need for the ADF Program Manager to interface with the external environment. In this case, external organizations were a frequent source of information. Similarly, the complex ADF Competition required frequent internal communications, particularly in support of alternative identification, evaluation, and data gathering information.

Table 8 looks at the problem solving steps again but shows the results of a comparison with the three communication tasks.

As Table 8 shows, the only significant correlation between the communication tasks and the problem solving steps was with information search activity. The search activity was correlated with the problem solving steps of identifying alternatives, gathering data and evaluating the alternatives. Gathering data was the most strongly correlated with a p-value of .0001. Both the identifying alternatives and evaluating steps had a p-value of .0004. This last result, and the previous significant correlations between document flow and information search (Table 6) and between document flow

Table 8

Contingency Coefficient/p-value: Communication Tasks vs. Problem Solving Steps

	Information Search	Intra-Org. Coordination	Extra-Org. Coordination
Problem Definition	.012/.9732	.030/.7645	.043/.6103
ID Alternatives	**.228/.0004**	.069/.3486	.088/.2138
Gather Data	**.243/.0001**	.023/.8199	.089/.1907
Evaluation	**.228/.0004**	.069/.3486	.088/.2138
Decision	.085/.3446	.079/.3549	.008/.8163

BOLDFACE: Statistically significant at .05

these same three problem solving steps (Table 7) strongly supports that the ADF program management team needed to search out information, from both internal and external organizations, to assist in the efforts to define and evaluate alternatives while also gathering data to support those tasks.

The results in Table 8 also indicate that the other two communication tasks, intra-organizational coordination and extra-organizational coordination, were not found to be related to any of the five problem solving steps. Therefore, both intra-organizational and extra-organizational coordination were equally important regardless of the problem solving step. Coordination was then an overall management problem solving objective. Finally, returning to the results in Table 6, the coordination objective was primarily handled internally through normal intra-organizational

communications and was handled externally through a combination of incoming and outgoing correspondence.

Table 9 shows the results of comparing the communication tasks with the four acquisition sub-processes.

Table 9

Contingency Coefficient/p-value: Sub-Processes vs. Communication Tasks

	Requirements	Budget	Acq Mgt	Contracting
Information Search	.077/.3346	.126/.0810	.087/.2111	**.235/.0002**
Intra-Organization Coordination	.015/.9917	.027/.8586	.080/.2463	.059/.4083
Extra-Organization Coordination	.038/.6932	.091/.2192	.004/.9420	.101/.1312

BOLDFACE: Statistically significant at .05

Only the contracting sub-process is correlated significantly with any of the three communication tasks. The p-value of contracting compared with information search is .0002. This particular result was expected. The issuance of a RFP is a complex undertaking. The PM must solicit from all interested parties their needs with respect to the contents and requirements to be included in the RFP.

The remaining three sub-processes were not correlated with any of the communication tasks. Since the ADF Program Manager was not an active player in the requirements sub-process, it was

expected that there would not be a significant relationship. Likewise, the budget sub-process was working without the active participation of the ADF PM. As stated above, budget documents were obtained from other sources for information purposes to support their program planning efforts.

Acquisition management documentation was expected to correlate with the two coordination tasks. However, common acquisition management documents such as the Program Management Plan, the Test & Evaluation Master Plan, etc. received almost no documented reference. Again, the fact that they did not was an indication of the relatively high importance of the contracting sub-process, and its documentation requirements, in the ADF Competition.

It was expected that the coordination tasks would have been correlated with one or more of the acquisition sub-processes and at least one of the problem solving steps. As discussed above in relation to Tables 4 and 6, the coordination activities were correlated with both document flow and time. Therefore, while they were an important activity, the coordination documents purpose were not identifiable with any one sub-process, although the search for information was closely tied to the contracting sub-process.

Table 10 shows the comparison results of the acquisition sub-processes versus the problem solving steps. The results are not unlike what was expected.

The requirements sub-process was correlated with the problem definition documentation (p-value: .0001). The comparison of

Table 10

Contingency Coefficient/p-value: Sub-Processes vs. Problem Solving Steps

	Requirements	Budget	Acq Mgt	Contracting
Problem Definition	**.284/.0001**	.100/.1858	**.193/.0025**	.124/.0640
ID Alternatives	.019/.9699	.021/.9738	.104/.1275	**.286/.0001**
Gather Data	.026/.8233	.020/.9262	.087/.1980	.122/.0621
Evaluation	.019/.9699	.021/.9738	.104/.1275	**.286/.0001**
Decision	.067/.5737	.015/.7203	.063/.4863	0.00/.7471

BOLDFACE: Statistically significant at .05

requirements in the other four steps, however, was very weak (p-values of .5737 to .9699). It was expected that the requirements sub-process would support the problem definition step tasks. In a case such as the ADF Competition, where the problem could be defined as which plane did the Air Force want to purchase, information from the requirements sub-process which defined what the organization needed, would contribute to the definition of the problem. The requirements sub-process was not expected to correlate with the other problem solving steps.

The budget sub-process was not related to any of the problem solving steps. This was consistent with what was discussed above with respect to document flow; the program management team tended to react to the budget sub-process instead of interacting with it. This was a function of the fact that funds were provided by the Congress out of existing F-16 program funding. There appeared to be

little for the ADF team to do except plan within those funding limits. In a program involved in POM preparation and submission, the budget sub-process might be expected to be correlated with identifying alternatives, gathering data, and perhaps evaluation.

Problem definition activities were the only problem solving step correlated with the acquisition management sub-process (p-value: .0025). The absence of correlation of the acquisition management sub-process in the other steps reflects the relative importance of the contracting documentation over that of the acquisition management process as mentioned above.

The contracting sub-process was strongly correlated to two of the problem solving steps - alternative identification (p-value: .0001) and evaluation (p-value: .0001). Although more likely to be the result of chance, it should be noted that contracting was also close in both problem definition (p-value: .064) and data gathering (p-value: .0621). These results indicate that during the ADF competition the Air Force implicitly relied upon the contracting process in four of the five problem solving steps with help during problem definition from the requirements and acquisition management sub-process.

In summary, Table 5 through Table 10 discussed various subcategory comparisons that were intended to focus on the actual workings of the ADF Competition decision making process. First, the flow of documents was related to the four acquisition sub-processes, the communication tasks and the five problem solving steps. Next, the communication tasks were compared with the problem solving steps and then the acquisition sub-processes. Finally, the problem

solving steps and the acquisition sub-processes were compared. The results of these comparisons showed that the contracting sub-process dominated the ADF management documentation. Contracting documents supported information search activity and provided identification of alternatives and alternative evaluation information. The contracting sub-process was found to be dominant with respect to internal coordinating activity and incoming documents from external organizations. The internal documentation flow was a probable reaction to the technical complexity of the ADF program while the external coordination was probably due to the complex management structure and powerful political influences. Overall, coordination appeared important as the primary means used to deal effectively with the complex situation facing the ADF Program Manager.

Table 11 begins the discussion of the ability of the overall weapon system acquisition process to support the decision analysis cycle. Specifically, Table 11 compares the eight decision analysis tasks with the subcategory time.

Only two of the decision analysis tasks were found to be significantly related to time. Like other subcategories discussed earlier, these had frequency peaks in the October through December 1985 time period. These results cannot, however, be relied upon for additional inferences. Of the eighteen total cells, the preferences subcategory showed six with an expected frequency of less than one. For the subcategory value, all eighteen cells had an expected value of

Table 11

Contingency Coefficient/p-value: Document Flow vs. Time

Decision analysis task	
Outcomes	.268/.3195*
Preferences (See text)	**.336/.0147**
Variables	.257/.4238*
Models	.295/.1247*
Probability	.272/.2838*
Uncertainty	.297/1176*
Value (See text)	**.430/.0001**
Risk	.224/.7422*

BOLDFACE: Statistically significant at .05

*: Invalid test due to expected frequencies < 1

less than one. For the other tasks, only a few cells had an expected frequency of more than one, thus making the test invalid.

Like Table 11, some subcategories in Table 12 had cells with expected frequency of less than one. For outcomes, preferences, variables, model, and risk, the data element for unknown flow (i.e. unable to identify) had to be adjusted out of the calculations. For the three remaining subcategories, probability, uncertainty, and value, the test was not valid since all cells had an expected frequency of less than one.

The outcome definition task was not correlated significantly with document flow. Of all of the decision analysis tasks, outcomes was the most frequent categorized as NA, or received indirectly.

Table 12

Contingency Coefficient/p-value: Document Flow vs. Decision Analysis Tasks

Decision analysis task	
Outcomes	.087/.7393
Preferences	**.302/.0001**
Variables	.167/.1136
Models	**.217/.0125**
Probability	.091/.7051*
Uncertainty	.137/.2891*
Value	.149/.2105*
Risk	.123/.4108

BOLDFACE: Statistically significant at .05

*: Invalid test due to expected frequencies < 1

The statement of preference task was significantly related to flow with a p-value of .0001. Incoming documents provided most of the preference information (49.38%) followed by internal documents (34.57%). This coincides with findings above (Table 5) that internal and incoming documents were the primary documents used in both the acquisition management and contracting sub-processes. Also, Table 6 showed that internal documents were used for information search activity along with outgoing requests to external organizations. The gathering of data was also related to information search (Table 8). Given a small lag for preparation and transmission time, the incoming information about preferences can be seen as a effort within the acquisition management and contracting sub-

processes to solicit this information from external organizations. This conclusion holds as well for the internal request for preference information. These results imply the following with respect to ODAM: preference information was available to the managerial level; the interface with the organizational level was an important consideration; and that the supporting level was used.

Most of the references relating to model information were found in incoming (42.86%) and outgoing (33.33%) documents. Above, information search was shown to be related to the problem solving task of evaluation of alternatives (Table 8) and the contracting sub-process (Table 9). Later, in Table 10, evaluation of alternatives was found to be related to the contracting sub-process. Finally, similar to the modeling information, many of the contracting documents were categorized as incoming (27.91%). Therefore, during the ADF Competition there was a pattern of requesting modeling information from external organizations to support evaluations as part of the contracting sub-process.

It should be remembered at this point that the primary benefits managers receive from decision analysis, in addition to its explicitness and inherent structuring of decision making, is the ability to deal effectively with future uncertainty and risk. The results discussed above are important with respect to the possible ability of the overall weapon system acquisition process to support decision analysis as it is incorporated into the ODAM. Specifically, although several expected frequencies were too low (less than one) to permit statistical inference, this fact alone emphasizes the relative lack of

attention that this critical decision making information received during the ADF Competition.

To better understand the possibilities for implementing decision analysis in the weapon system acquisition process, the next three tables present the results of comparisons between the decision analysis tasks and the communication tasks, the problem solving steps, and the four acquisition sub-processes.

Table 13 shows the results of the comparison of the three communication tasks with the decision analysis tasks. Only

Table 13

Contingency Coefficient/p-value: Communication Tasks vs. Decision Analysis Tasks

	Information Search	Intra-Org. Coordination	Extra-Org. Coordination
Outcomes	.099/.2041	.025/.8947	.041/.6972
Preferences	.094/.1786	.094/.1668	.052/.4887
Variables	**.255/.0001**	.106/.1290	.077/.2916
Model	**.319/.0001**	.005/.8586	.126/.0713
Probability	.142/.3435*	.099/.6208*	.039/.6283*
Uncertainty	.032/.8613*	.008/.6648	.078/.4809
Value	.017/.7256*	.099/.2649	.087/.3602
Risk	.024/.9318	.116/.1317	.072/.4324

BOLDFACE: Statistically significant at .05

*: Invalid test due to expected frequencies < 1

information search documents provided support for the decision analysis tasks. Information search was significantly correlated with

variable identification (p-value: .0001) and modeling (p-value: .0001). These results directly support the finding above that information search activity supported the decision analysis modeling task. In addition, variable definition information was also requested during the information search activity. Note, again, that several subcategory comparisons were invalid due to expected frequencies less than one.

Table 14 shows a correlation between the problem solving steps and several of the decision analysis tasks. Problem definition was significantly related to the identification of outcomes (p-value: .0099). Efforts to identify alternatives were related to the subcategories of preferences (p-value: .0038), variables (p-value: .0001), and models (p-value: .0001). Data gathering documents were shown to be significantly related to the same three decision analysis tasks as were evaluation documents. Decision documents were shown to be related to probability, but the test was invalid because it contained expected frequencies less than one.

Finally, Table 15 compares the eight identified decision analysis tasks with the four acquisition sub-processes.

The requirements sub-process was found to support the decision analysis tasks of determining preferences (p-value: .0004) and defining outcomes (p-value: .0234). The budget sub-process was a significant contributor to the outcomes task with a p-value of .0038. This was not expected. The evidence, however, showed that several documents that were playing an important role in the PPBS were also important sources of information for the PM when

Table 14

Contingency Coefficient/p-value: Problem Solving Steps vs. Decision Analysis Tasks

	Problem Definition	Identify Alternatives	Gather Data	Evaluate	Decision
Outcomes	**.178/.0099**	.051/.6307	.015/.9892	.051/.6307	.109/.2652*
Preferences	.108/.1138	**.186/.0038**	**.296/.0001**	**.186/.0038**	.006/.7968
Variables	.049/.5825	**.270/.0001**	**.210/.0010**	**.270/.0001**	.020/.8764
Models	.052/.5911	**.309/.0001**	**.186/.0045**	**.309/.0001**	.015/.7203*
Probability	.027/.3536*	.027/.3636*	.069/.9081*	.027/.3636*	**.012/.0157***
Uncertainty	.054/.8462*	.029/.8314*	.048/.7834	.029/.8314*	.136/.3610*
Value	.091/.3900*	.014/.6959*	.044/.7947	.014/.6959*	.028/.4663*
Risk	.025/.9578	.030/.9833	.083/.3106	.030/.9833	.072/.7817*

BOLDFACE: Statistically significant at .05

*: Invalid test due to expected frequencies < 1

identifying possible outcomes. A good example of this was the early concern that the F-20 proposal would jeopardize the F-16 multi-year which was then before the Congress for approval.

It was also expected that the acquisition management documents would be more supportive of decision analysis than they were. Only the modeling task would find significant support from the acquisition management sub-process. The contracting sub-process was found to be significantly related to both the modeling and variable identification task. Both of these results are reasonable because of the work done in the contracting sub-process to define evaluation criteria and write the Statement of Work (SOW) for inclusion in the RFP.

Table 15

Contingency Coefficient/p-value: Sub-Processes vs. Decision Analysis Tasks

	Requirements	Budget	Acq Mgt	Contracting
Outcomes	**.163/.0234**	**.203/.0038**	.015/.9892	.046/.6159
Preferences	**.226/.0004**	.043/.6490	.078/.2605	.016/.8940
Variables	.015/.9491	.033/.8382	.101/.1440	**.166/.0110**
Models	.008/.8015	.087/.3215	**.148/.0280**	**.206/.0014**
Probability	.021/.1908*	.018/.1213*	.055/.9081*	.062/1.000*
Uncertainty	.160/.0714*	.078/.7392*	.077/.4596	.124/.1306
Value	.135/.1436*	.061/.8689*	.123/.1193	.028/1.000
Risk	.005/.6334*	.021/.7821*	.043/.7249	.104/.1748

BOLDFACE: Statistically significant at .05

*: Invalid test due to expected frequencies < 1

In summary, the eight decision analysis tasks were only partially addressed in the ADF Competition documentation. Four of the tasks; probability, uncertainty, value and risk, were not significantly related to any subcategories at all.

Of the four tasks remaining, preferences and models were related to document flow. Preferences were found most in incoming (49.38%) then internal (34.57%) documents while modeling information was found most in incoming (42.86%) then outgoing (33.33%) documents. The correlation of preferences with the incoming and internal flows substantiates the need to interface with the larger organization and to involve multiple functions within the unit. Both

of these activities sought to gain organizational consensus concerning preferences.

Modeling was also correlated with information search. Modeling information was requested in 29.27% of the information request documents. The variables task was also correlated with information search. Information search documents requested information about decision variables in 40.0% of those documents.

Documents associated with the five problem solving steps were correlated with only four of the decision analysis tasks. Documents concerned with defining the problem were correlated to the identification of outcomes. The identification of alternatives step correlated with three tasks: preferences, variables, and models. Gathering data and evaluation also correlated with preferences, variables and models. The problem solving steps, therefore, resulted in information being generated that would allow the creation of only a simple deterministic model. Outcomes were defined, preferences were stated and models and variables were defined with which to evaluate alternative solutions. This approach, however, was founded totally upon an assumption of a certain future. There was no information relating to uncertainty and risk. Also, the five problem solving steps did not elicit from the organization a statement of its relative values for the various outcomes.

The requirements sub-process provided information on outcomes and preferences. The budget sub-process also provided outcomes information. The acquisition management sub-process provided modeling information while contracting provided

information on both variables and modeling. Therefore, the four sub-processes provided information to address only basis development (Step 1) and deterministic structuring (Step 2) of the decision analysis cycle

In summary, four decision analysis tasks were found correlated with the sub-processes. However, it appeared that the ADF Competition decision making process virtually ignored future uncertainty, value and risk in its activities. Also, when searching for additional information, only data on variables or modeling were sought. Overall, while several aspects of the decision analysis cycle were addressed in the ADF Competition decision process, the ability of the sub-processes, the five-step problem solving approach, and normal coordination cycles to provide information useful for incorporating into stochastic models and analyzing organizational attitudes toward risk was missing.

Analysis Results and Summary

The remainder of this chapter synthesizes the results of the categorization and the statistical analysis of the program documentation. The intent was to identify possible evidence of applicability of the ODAM to the decision making tasks of the acquisition Program Manager and also to determine if ODAM should be modified to account for actual circumstances. The synthesis follows directly the ODAM structure as presented in Chapter IV. First, the organizational level characteristics will be discussed

followed by the managerial level. Lastly, the supporting level elements of the normative decision making model will be discussed.

Organizational Level. The Organizational Level is summarized in Figure 18. First the inputs will be discussed, then the process, and finally the outputs.

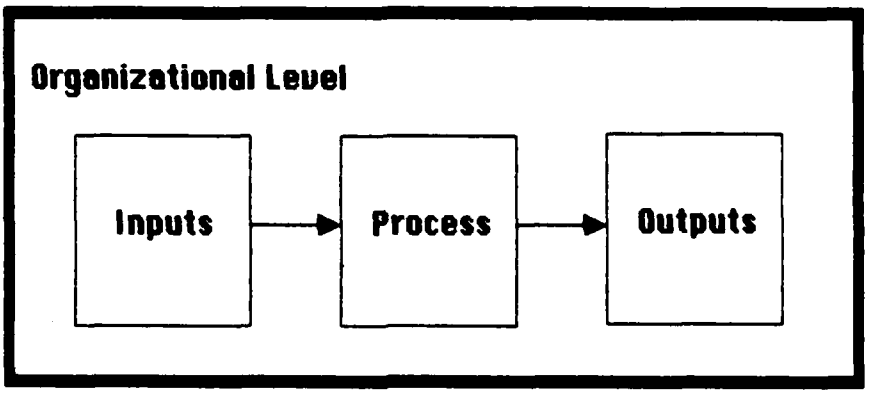

Figure 18
Organization Level Summary

The structure of the ADF Competition decision making unit was hierarchical. For the purposes of this study, the focus was on the acquisition PM located in ASD/TA-2. This was a position within the organization set up especially for the purpose of managing the ADF Competition. Depending on the acquisition sub-process being discussed, the relative position of ASD/TA-2 within the hierarchy in terms of decision making authority varied somewhat.

In a briefing given by AFSC/CC to the DEPSECDEF on 20 January 1986, the structure for the contracting sub-process proposal evaluation was defined as shown in Figure 19.

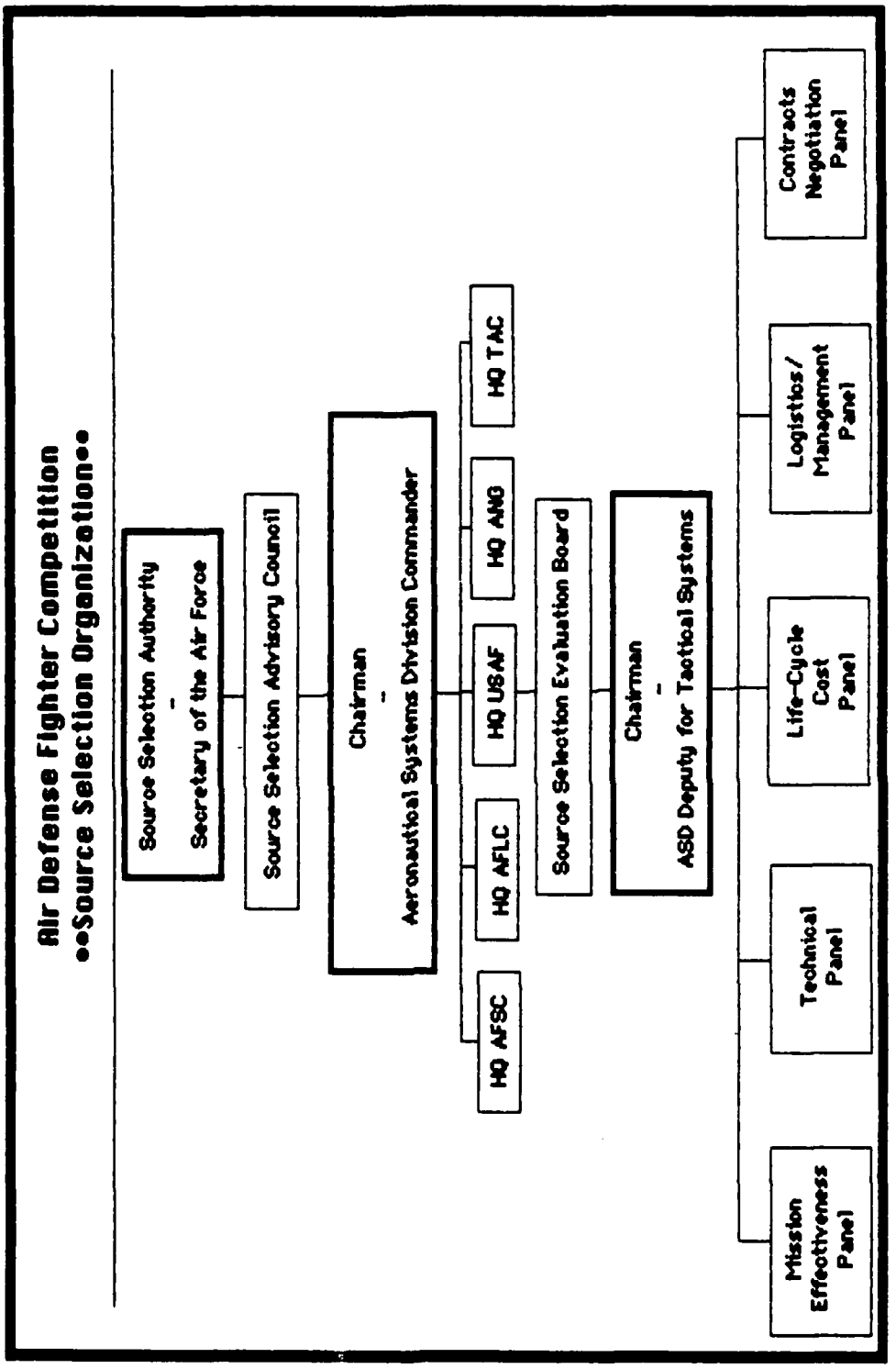

Figure 19

ADF Source Selection Organization

The Source Selection Authority (SSA) was the Secretary of the Air Force (SAF). This was not unusual for a program of this magnitude and political sensitivity. For example, the SAF was also the SSA for the Advanced Tactical Fighter (ATF) Demonstration and Validation program source selection which was also being completed at the same time as the ADF Competition.

The Source Selection Advisory Council (SSAC) was a body with the Commander of ASD as Chairman which was to provide the final recommendation to the SSA. The SSAC was made up of representatives from various major commands as shown in the figure.

The detail work to be accomplished by the Source Selection Organization was the responsibility of the Source Selection Evaluation Board (SSEB). The SSEB was chaired by ASD/TA. The five specialized functional panels that made up the SSEB were the Mission Effectiveness Panel, the Technical Panel, the Life Cycle Cost Panel, the Logistics/Management Panel and the Contracts Negotiation Panel. The first four of the panels corresponded to the four evaluation areas defined in the Information to Offerors (ITO). The Contracts Negotiation Panel was responsible for the actual conduct of the negotiation phase of the source selection up to the final award of the contract to the winner of the competition.

ASD/TA-2 was the Director, Air Defense Aircraft Procurement Program. Assigned to ASD/TA, this individual was ASD/TA's primary assistant for all matters dealing with the ADF Competition. It was ASD/TA-2 who signed most routine documentation associated with

the program and who handled the bulk of the ADF management team administrative tasks. ASD/TA maintained a similar position during the Dual Role Fighter (DRF) Competition. At that time it was called 'TA-1'. Both positions provided a visible focal point within the organization for all matters pertaining to these special activities.

Ultimately, the definition of Program Manager used in this study must be split between ASD/TA and ASD/TA-2. While ASD/TA-2 appeared responsible for day-to-day management of the competition program, virtually all documentation pertaining to direction of the program, particularly outgoing documents, were signed by ASD/TA. Therefore, when discussing the Managerial Level in the next subsection, it will be from the acquisition management perspective of ASD/TA, with the acknowledgement that many of the specific tasks might have been delegated to an individual like ASD/TA-2.

The structure for the requirements sub-process centered on AF/RDQ (Director for Operational Requirements). Other key players in this sub-process were AFSC/SD and TAC/DR (Deputy Chief of Staff for Requirements). Also involved were ASD/TA, NGB/CF (National Guard Bureau), and ADCOM/XP (Air Defense Command). ASD/TA played an important role even though not a key participant. In the drafting and review of the SON, both TAC and the Air Staff were concerned that the SON reflect reasonable requirements in terms of the two primary contenders while not, a priori, eliminating any others (e.g. F-4, F-18, etc.).

In a similar vein, ASD/TA was not critical in the budget sub-process. The ADF Competition was funded from the F-16 program. The amounts per year and the years included were a given. This funding information was determined by the Congress. When the PMD was signed on 21 November 1985, the funding line was given as shown in Table 16.

Table 16

ADF Program Funding Profile

	FY87	FY88	FY89	FY90	FY91	To Complete
Appropriation						
3010	429.3	664.0	733.5	742.1	749.3	TBD
3600	28.0	0	0	0	0	0
Quantity	30	60	60	60	60	30
($ in millions)						

The acquisition management sub-process centered on both ASD/TA and Director of Operational Requirements in the Air Staff (AF/RDQ) with a significant role played by AFSC/SD (Deputy Chief of Staff for Systems). Most documented activity during the period April 1985 until December 1985 in the acquisition management sub-process dealt with the attempts of the Air Force to issue program management direction for the ADF Competition. As discussed in

Chapter II, the critical document in this early stage of any program is the Program Management Directive (PMD). The PMD for the ADF Competition was issued by AF/RDQ on 21 November 1985. Coordination activity concerning the PMD primarily centered around the desire on the Air Force's part to meet stated Congressional requirements for a full and open competition to be completed by 1 July 1986 and the often conflicting requirements of existing law and regulations which govern how the Air Force must manage major weapon system procurements. The role ASD/TA played in this process appeared to be one of the single conduit through which information flowed between the ASD functional staff, the contractors, the using command (TAC), and the Air Staff. AF/RDQ, not ASD/TA, however, was the driving force in this sub-process.

In the ADF Competition, ASD/TA played a central role in only the contracting sub-process. This was expected since contracting was the most prevalent activity found in the documentation. It is apparent, however, that there was not a single simple organizational structure at work within the Air Force at this time to deal with the ADF issue. Four sub-processes were at work simultaneously and each sub-process had its own focal point. Therefore, a task critical to the success of the program was the ability of ASD/TA to differentiate among the sub-processes while ensuring that all tasks, regardless of the sub-process, contributed effectively to the accomplishment of the overall organizational task, which was the successful completion of a 'full and open' ADF competition.

The reliance upon established, formal procedures was evident in all phases of the competition. Within each sub-process, the participants were aware of and often made reference to the regulatory requirements concerned with the task they were performing.

This was particularly true of the contracting sub-process. The Federal Acquisition Regulation (FAR) strictly governed the conduct of procurements for major weapon systems by the Federal government. In his 20 January 1986 briefing to the DEPSECDEF, AFSC/CC devoted an entire slide to a comparison of the stages of the procurement, the major activities within each stage and the governing statutes and regulations. Referenced were several statutes, the FAR, two AF regulations, the FY86 Continuing Resolution Authority (CRA) law passed by the Congress, and waivers and deviations required in order to meet other requirements (e.g. schedule). As mentioned above, waivers to procedural schedule requirements were necessary because the FY86 CRA required "... the Air Force to make source selection by 1 July 1986 with contract award to follow in sixty days." Normal operations in accordance with the established laws and regulations would not have permitted meeting that date.

Little is mentioned in the documentation of the personnel used in the decision making process. Only one individual is brought in and mention made of his qualifications. ASD/TA recommended to ASD/CC on 26 September 1985 that he would personally head the ADF Competition program but would use ASD/TA-2 as 'project officer'

ASD/TA-2 was chosen based on operational flying experience in air defense, prior acquisition experience, and related job experience at the Air Staff.

Environmental influence came from primarily the Congress, the DOD and the Office of the Secretary of the Air Force (OSAF). Congressional influence came in the form of the FY86 Authorization Act and the FY86 Continuing Resolution Authority.

The FY 86 Authorization Act stated that "... during FY86 a competition for the procurement of fighter aircraft... among all suitable aircraft..." should be established. Additionally, the competition was to be accomplished in accordance with all applicable provisions of law including reference to sections from Title 10, USC, relating to the Director of IOT&E (Section 136a), to independent cost estimation (Section 139c), and to competition in contracting (Section 137). These requirements, coupled with the FY86 CRA requirement for a 1 July 1986 source selection decision mentioned above, provided the single most important element the the early planning had to overcome.

Environmental influence from within the DOD and OSAF came in the form of oversight and review by staff elements. In addition to the normal reviews associated with these sub-processes (e.g. Defense Resources Board and the Defense System Acquisition Review Council), other groups were established to guide the ADF Competition. For example, a 1 November 1985 memorandum from the Assistant Secretary of the Air Force for Research, Development and Logistics (SAF/AL) established an ad hoc group to " examine the

factors/elements which will form the basis of the cost determination in [the] competition" (Cooper, 1985). The purpose for such a group was to ensure that cost information made available to the SSA was appropriate and comparable.

Some aspects of the organizational level inputs made the decision making process easier: well structured organizational relationships and a clearly defined hierarchy of decision making authority, extensive procedural guidelines to ensure the many aspects of the decision were adequately addressed, and personnel available to handle the tremendous workload involved with a major system source selection. However, some aspects of the inputs made the process less easy to manage: there were no clearly defined structural boundaries, the procedures within each sub-process did not always track with progress in the other sub-processes, and the environment provided constraints upon the decision making process that were not consistent with the many requirements existing in the sub-processes.

The process at the organizational level in the ADF Competition clearly reflected the coordinate, compromise, and consensus model in the ODAM. In the contracting and acquisition management sub-processes, the 25 September 1985 message from HQ AFSC/PK, Subject Air Defense Fighter Competition, addressed participants at the Air Staff, ASD, HQ TAC, HQ AFLC, the Logistics Operations Center, and the AF Acquisition Logistics Center. The purpose of this early communication was to begin a "... round table discussion on the business strategies for the Air Defense Fighter Competition." Such a

document is evidence of the overall organizational process of seeking a consensus from all relevant participants as to the best direction in which to proceed

Similarly, at the direction of ASD/CC, ASD/TA set up a team to manage the ADF Competition As part of his efforts to form this team, ASD/TA solicited from the larger organization outside ASD inputs from other interested offices The nature of these inputs was to serve as "devil's advocates" ASD/TA stated in a series of 3 October 1985 letters to these devil's advocates that his "goal is to resolve as many of these issues in advance as we can so we can clearly articulat[e] [and] resolv[e] critical programmatic issues" Furthermore, the ASD/TA stated objective was to

"reduce the total number of unresolved issues prior to briefing the senior leadership of the Air Force" (Teal, 1985)

Other coordinating activity occurred during the program but is categorized as supporting level coordination This activity will be discussed below

Outputs at the organizational level were primarily the products of the individual sub-processes The major product of the requirements sub-process was TAF SON 310-85, Air Defense Fighter The Program Management Directive issued on 21 November 1985 served as the primary output of the acquisition management sub-process

The budget sub-process, while less visible in this decision making cycle, resulted in changes to the Five Year Defense Program (FYDP) and on 7 January 1986, a Program Budget Decision (PBD)

signed by the DEPSECDEF, detailing the funding requirements of the ADF Competition The budget sub-process, as part of the PPBS, produces documents which most systematically relate to plans (program descriptions and costs), action (documents that actually provide funding to implementing organizations), and control (tracking of obligation and expenditure rates)

The contracting sub-process produced the RFP and later the contract By their very nature, these two documents provided for a plan of action and the means to control that action In addition, the contracting sub-process produced several other subsidiary documents that also served the purposes of planning, acting, and controlling For example, a Source Selection Plan (SSP) was written and coordinated, as was the Instructions to Offerors (ITO) which accompanied the RFP

In summary, the Organizational Level of the ODAM accurately represents the decision making system at work throughout the ADF Competition The inputs of structure, procedures, and the environment all were significant in their effect upon the conduct of the decision process Only the personnel element was not frequently mentioned in the documentation, although the one time it was mentioned, it involved a pivotal position in the decision making unit.

Drucker's coordinate, compromise, and consensus paradigm clearly was important A wide cross-section of Air Force organizations were participants in the decision making process. Finally, the bureaucratic nature of the Air Force resulted in several documents that fulfilled the output requirements of the ODAM.

Plans were written and approved, action was taken contingent upon authorizing and justifying documentation, and control was exercised via program management reviews and the normal functioning of the PPBS.

Managerial Level. The Managerial Level activities are summarized below in Figure 20. The Managerial Level was much less well represented in the ADF Competition documentation than was the Organizational Level. Insofar as the Managerial Level focused upon the Program Manager, this implies that either a structured and explicit decision making framework as reflected in the ODAM was lacking, or that another such framework was used in its place.

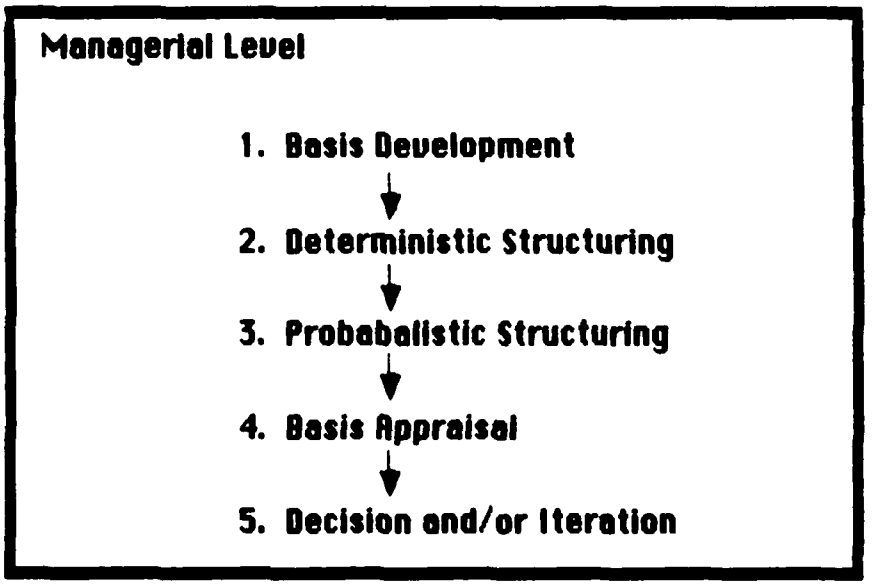

Figure 20

Managerial Level Summary

As mentioned above, the 9 September 1985 message from ASD/CC to AFSC/CC addressed this issue directly. The message stated that there "...[did not] seem to be any formal, structured dialogue on the subject" (McMullen, 1985) of what to do about the F-20. The message went on to state that much of the information circulating did not fully consider the ramifications and veracity of program proposals. ASD/CC stated that without a formal and structured process for making basic programmatic decisions, there was a chance that the "wrong decisions" might be made.

The decision analysis cycle introduced in Chapter II makes up the Managerial Level. Only aspects of Step 1 of the cycle, the development of the decision basis, were addressed in the ADF Competition.

Step 1 of the decision analysis cycle, Basis Development, benefits from the documents reflecting organizational preferences for different aspects of the ADF Competition. The fact that preferences were so often stated is a function of the fact that a primary purpose of intra-organizational and extra-organizational communications was to transmit an organization's preference for a given topic under consideration. This activity then supports the decision analysis cycle.

Deterministic Structuring, Step 2 of the decision analysis cycle, was supported in the ADF Competition by the documents dealing with the identification of decision relevant variables and modeling.

The third most frequently documented decision analysis task was the identification of outcomes. This activity supported basis Development in the decision analysis cycle. Next most frequent was

documentation referring to models. Since very little documentation reflected any concern for the uncertainty inherent in the decision, this activity must be related primarily to Step 2, Deterministic Structuring. If uncertainty is taken into account in the computer modeling discussed in the documentation, it is not apparent in the documentation. The Program Manager in such a situation would not be able to articulate to others, much less defend, a position based upon an assumption of future likelihood of an outcome Information concerning uncertainty was not available to the decision maker

Risk is another aspect of decision analysis which must now be addressed. The use of the concept of risk in the documentation varies. In a 15 April 1985 memo to ASD/CC, the Deputy for ASD/TA states that " . . as a result of [the F-20 proposal] we may lose the F-16 multi-year." Such an outcome would adversely affect force structure and would raise the per unit cost of the F-16s bought under the contract. In the 2 May 1985 response to AFSC/SD presenting the ASD evaluation of the Northrup unsolicited proposal, mention was made of the " . . risk associated with achieving [the] levels of R&M" proposed. It is unclear whether this statement referred to that fact that it was uncertain if the F-20 could actually attain the levels of R&M proposed or whether the Air Force had to acknowledge the chance that an outcome less than that desired may occur.

Similarly, a 5 December 1985 memo from ASD/TA to ASD/CC, presents the results of a meeting at which ADF Competition issues were discussed among members of the highest management levels

within the Air Force (SAF/AL, USAF/CV, AF/RD, TAC/CC, AFSC/CC, AFLC/CC and ASD/CC). Issues were stated by each of the participants as implicit desires to avoid possible negative outcomes which might result from the competition. For instance, SAF/AL was concerned that the acquisition business strategy should allow the F-20 to compete. USAF/CV was concerned that the Air Force comply with Congressional direction while at the same time maintaining the integrity of the tactical fighter budget.

Step 3 of the decision analysis cycle, Probabalistic Evaluation, was therefore not well evidenced in the documentation. Sensitivity analysis, whether deterministic or probabalistic, was not apparent at all.

As discussed in Chapter II, Step 4 Basis Appraisal deals with the evaluation of the basis in terms of the value of information. If the value of additional information exceeds the benefits to be gained from that information, then it is time to make the decision. There was no evidence that any consideration was given to the value of information. The information search activity undertaken was primarily driven by procedural requirements or in reaction to the stated requirements and desires of other organizational elements or powerful constituencies (e.g. Congress).

The breakdown of information search activity among the sub-processes was found to be: requirements at 4.2%, acquisition management at 29.2%, contracting at 66.7%, and budget at 0%. No information search was undertaken in the budget sub-process and very little was done during the requirements sub-process.

As previously discussed, the bulk of information search documentation concerned preferences (32.7%), variables (26.9%), and modeling (23.1%). This search activity coincided with either requests from other organizations for their views to be considered or from the procedural requirements for inputs from other organizations (external) or functions (internal). The documentation does not support a determination that the ADF Competition management, or the sub-process procedural requirements, explicitly considered the value of information in the decision making process.

In summary, the Managerial Level did not appear to reflect a well structured decision making process as portrayed in the ODAM. Evidence that another such structured process was used is also not evident. The management process at work appears to be one of reacting to requirements from outside the decision making unit (e.g. Congress primarily).

Supporting Level. The Supporting Level is summarized in Figure 21. Internal coordination of documents began early in the ADF Competition. While somewhat limited during the first phase of the competition (i.e. evaluating and responding to the Northrup unsolicited proposal) to organizational elements immediately affected by the issue and the tasking for the evaluation (e.g. AF/RDQ, ASFC/SD, and ASD/CC/TA), by early October 1985, more formal support was required from a broader range of organizational interests and functions.

In a 3 October 1985 letter to various ASD organizations, ASD/TA requested support for the formation of an ADF Competition team.

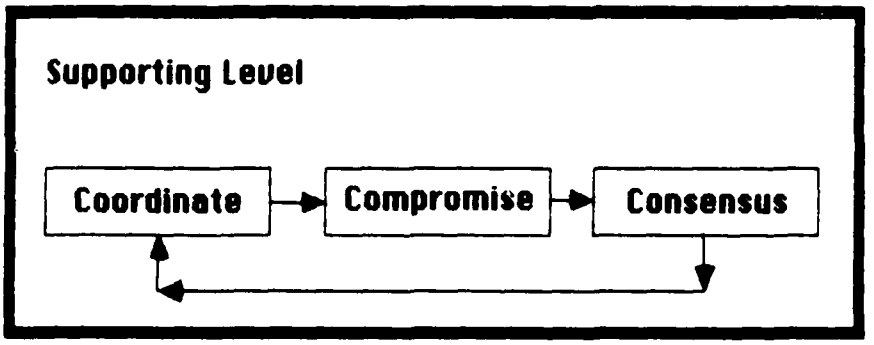

Figure 21

Supporting Level Summary

This team formed the nucleus of ASD intra-organization coordination throughout the remainder of the program. The team consisted of ASD/TA-2, ASD/TAAE/TAAT/TAAK/TAAL/TAAF, ASD/TAL, ASD/TAD, ASD/TAK, ASD/TAP, ASD/YZF, ASD/TACSO-A, AFLC/JANA, and ASD/YPRD

Also, in key documents being submitted to ASD/CC for approval, the concurrence of other key ASD managers (ASD/YP/AV/PM/AC/YZ) was obtained Finally, documents routed to ASD/CC either for information or for approval were routinely submitted through the ASD/CC staff - ASD/CS and ASD/CV.

In summary, the relevance of the Supporting Level of the ODAM was substantiated in the ADF Competition. Also, the documentation reflected that supporting level activities were an important part of the actual management of the ADF decision making process.

Summary

This chapter compared the Air Defense Fighter Competition with the Organizational Decision Analysis Model (ODAM) developed in Chapter IV. First, an historical overview of the competition was presented beginning with the receipt of the Northrup unsolicited proposal on 2 April 1985 until contract award was announced on 31 October 1986. Next, the results of the categorization and statistical analysis of the ADF Program Manager's documentation, according to the requirements of the ODAM, were summarized and discussed. Finally, the ADF program documentation was analyzed with respect to its correlation to the three levels of the ODAM.

In the next chapter, the entire study will be summarized, conclusions presented and recommendations made.

VI. Summary and Conclusions

Introduction

Air Force acquisition Program Managers (PM) are faced with the task of integrating a complex mix of goals, objectives and procedures from four sub-processes within the major weapon system acquisition process. This complexity is compounded by the dual roles of the Program Manager: traditional manager coupled with primary program advocate.

The many rules and procedures of the four sub-processes constitute a complex milieu for allocating the resources under the control of the acquisition Program Manager. This complexity is the result of the necessary fragmentation of tactical objectives and operational rules between the sub-processes. This fragmentation affects the ability of the Air Force to efficiently make a decision and then to implement that decision as effective action. Managerial decision making efficiency requires a structured information generation process while implementation effectiveness requires explicit and unambiguous communication of relevant facts.

This study has shown that the Air Force lacks an overall conceptual organizational decision making framework for the acquisition Program Manager. Such a framework would efficiently and effectively guide the PM faced with these fragmented decision making rules and procedures. While decision analysis appeared to offer a means of solving this problem, the technique had not yet

been applied to organizational decision making situations similar to that of the weapon system acquisition Program Manager

Conclusions

The purpose of this study was to develop a normative decision making model to integrate and guide decision making processes in large bureaucratic organizations like the Air Force. There were two main problems to overcome. First, was to understand, in as broad a perspective as possible, the complexities inherent in the Air Force acquisition decision making process to include the internal tasks that a PM was required to accomplish and the external forces under whose influence these tasks were to be done. Second, was to define how to integrate a decision making methodology, intended for use only in individual decision making situations, into a large complex group decision making situation in the Air Force bureaucracy.

The overall objective of this research was to provide better understanding of the organizational decision making processes in the Air Force acquisition arena in terms of information generation and communication. Specifically, the study sought to:

1. develop a normative decision making model for use in the weapon system acquisition management process which integrated decision analysis principles and procedures,

2. test this model against an actual program management decision, and

3. draw conclusions about the implementation of the model into acquisition management procedures.

The primary work necessary to accomplish the study objective was divided into two parts. First, the results of the literature review were used to create a model of organizational decision making incorporating the principles of decision analysis - the Organizational Decision Analysis Model (ODAM). Second, the Air Defense Fighter (ADF) Competition decision was compared to the basic attributes of the ODAM. The purpose of the comparison was to identify whether the ODAM could improve the PM's decision making in the organizational setting of the DOD weapon system acquisition process.

The remainder of this section will discuss the conclusions and recommendations associated with each of the objectives mentioned above.

Normative Model Development. The first objective of the study was to develop a normative decision making model for use in the weapon system acquisition management process which integrated decision analysis principles and procedures. The development of the Organizational Decision Analysis Model (ODAM) met that objective.

As discussed in Chapter II, a previous limitation in the use of decision analysis was that it could only be used as a tool for **individual** decision making. For the acquisition PM this was unacceptable. The complex nature of weapon system program

management dictated the involvement not only of many people but also of many different organizations.

Howard stated that managers in organizations act on behalf of the organization. This implies that the "... individual who as principal devolves some decision making authority upon an agent is making a decision in that devolution... and thus, whether as principal or agent, everyone is making individual decision making" (Howard, 1983a: 181). Howard goes on to say, however, that **group** decision making can be considered for decision analysis only if the individuals comprising the group are "acting collectively in accordance with an agreement" (Howard, 1983a: 181).

The essential central point of the ODAM is the provision for the reaching of a consensus (collective agreement) both at the organizational level where strategic goals and objectives are determined and at the unit, or operational, level where the specific expertise exists to generate information to solve the problem. The inclusion in ODAM of Drucker's coordinate, compromise, consensus paradigm answers Howard's need for collective agreement. It does this by ensuring that the end product of the decision (the action) meets the needs of the organization as a whole and that the detailed information used during the decision analysis cycle is complete and correct.

Adequate coordination within the unit and throughout the organization was not sufficient taken alone. DOD acquisition decision making is not carried out in isolation. Therefore, ODAM also acknowledged that the Program Manager must assess the resources

the decision process will utilize and the constraints it will encounter. Listed as inputs at the organizational level of ODAM, these include the existing organizational structure, established procedures, available personnel, and the state of the environment with regard to the specific decision to be made. The nature of the inputs must be understood at the beginning of the decision process and must be reviewed often.

The Program Manager, as choreographer of the decision analysis cycle, transforms information into an implemental decision. For a decision to be effective, there must be a commitment to action. The outputs of ODAM address this aspect of decision making. At an organizational level there must be a plan that says what will be done, which then generates action as a result of the decision, and which can be effectively controlled by management using the explicit and unambiguous information provided by the decision analysis cycle.

However, the weapon system acquisition process is dynamic as well as complex. This dynamic or changing nature implies that the future is not certain. In addition, weapon system development and acquisition programs can now last ten years or more. It is impossible to predict what will occur one year in the future much less ten or fifteen years. Decision analysis came into being to deal not only with the complexity discussed above, but also to allow managers to deal with the future and the uncertainty inherent in it. Uncertainty in decision analysis is represented by subjective probabilities. These probabilities are based upon the judgments of

experts and/or accepted by the decision makers. Attitudes toward risk are assessed which capture the feelings of the organization toward the possible negative outcomes that might result from the decision.

Explicit values for each outcome are also agreed upon so that unambiguous quantitative comparisons of alternatives can be accomplished and reviewed. The result of this process is that more informed and defensible decisions are made thus improving the effectiveness of the Program Manager and the organization as a whole.

Since it has been shown that the ODAM can provide structure to problem solving, improve information generation and communication activities, and deal effectively with complexity and uncertainty, it is recommended that the Air Force implement training programs addressing normative models of organizational decision making. Specifically, the ODAM should be included in the Professional Military Education (PME) curricula to expose managers to management techniques of decision making processes that offer a broader view of the complex organizational processes at work during the decision making process. This would help managers efficiently create explicit documentation of all information relevant to the decision to be made, while accepting future uncertainty as a reality and providing a means to effectively deal with it.

A second recommendation is that the Air Force Institute of Technology prepare and teach graduate level and Professional Continuing Education (PCE) courses that educate Air Force managers

in organizational decision making. At the graduate level, these courses should be inter-disciplinary and bring together relevant topics to include organizational structure, organizational effectiveness, decision analysis, subjective probability theory, decision support system, and the use of automated tools (e.g. simulations) to support organizational decision making. Part of this program should be frequent interchange of ideas between the management practitioners in the School of Systems and Logistics and the technical specialists in the School of Engineering. For example, once a quarter, an informal student/faculty symposium could be held at which time students and faculty would have the opportunity to present organizational decision making related research proposals, findings and recommendations for discussion by the group.

In PCE courses, AFIT should present to students (especially program managers in SYS 100, SYS 200, and SYS 400) the basic objectives of the ODAM and how they could implement it in their own offices to make their decision making more efficient and effective. For the less experienced program managers, the complexity issue and how ODAM deals with it should be introduced. For more experienced managers, the issues of organizational values, uncertainty and risks could be introduced. In both cases, however, the documentation and communication tasks implied by the model must be stressed.

A third recommendation is that AFIT thesis research be managed within the broad area of organizational decision making to produce a richer understanding of both the problems to be overcome

in implementing a framework such as ODAM and the possibilities available to Air Force managers to improve the effectiveness of their decision making role.

Comparative Analysis of Model. The study's second objective was to test the ODAM against an actual program management decision. This objective was met by comparing the program management documentation from the Air Force's recent Air Defense Fighter (ADF) Competition decision to the ODAM. There were two sub-objectives applicable to the case study. First, the case study was to provide a solid and realistic foundation as the practical point of reference for drawing conclusions about the applicability of the ODAM. Secondly, it was desirable to determine if existing procedures within the acquisition system provided the kinds of information required by decision analysis techniques.

The first sub-objective was accomplished by categorizing the ADF documentation in accordance with the methodology defined in Chapter III and summarized in Figures 10 and 11. Next, the data from the categorization were statistically analyzed for correlation between relevant sets of subcategories. The most prominent results of this analysis are discussed next.

The statistical analysis first investigated the subcategory time. The intent was to understand the relationship of the documents to the key points during the decision process: the unsolicited proposal review (2 April - 2 May 1985), the issuance of the ADF Program Management Directive (PMD) on 21 November 1985, the validation of the ADF Statement of Need (SON) on 6 January 1986, and the release

on 24 March 1986 of the ADF Request for Proposal (RFP). Documents from three of the sub-process were correlated to time: budget, acquisition management and contracting. This was expected since the unique activities required by each sub-process would necessarily precede the major documents they produced.

The requirements sub-process was an exception to this. It was expected that activity to define requirements would occur early in the decision cycle. This expectation was reinforced by results showing that documents categorized as problem definition, preferences, and value were found to be correlated with time and exhibited an observed frequency early in the cycle. The fact that requirements differed indicated that the Program Manager used supplemental information to support the early decision process. Therefore, the requirements sub-process was not fully able to fulfill its function, although the nature of the decision initiation (i.e. unsolicited proposal) provided a ready explanation why this was the case.

Each of the four sub-processes, in general, displayed correlation with a different mix of subcategories. The requirements sub-process did provide information that helped define the problem, identify outcomes and state preferences for outcomes. Although problem definition and preferences were correlated with time as well, outcomes, like the requirements sub-process, was not. Therefore, it appeared that the ADF Competition PM did not seek to independently identify possible outcomes of the decision.

The budget sub-process was not active in the decision process, at least not from the perspective of the ADF program manager. Although budget documents were correlated with both time and the identification of outcomes, it was noted that budget documents were mostly in the flow subcategory element 'not applicable' (i.e. indicating an indirect and undefined routing to the PM). Therefore, it was likely that the correlation to time was driven by the PPBS cycle and not the ADF Competition decision process.

The acquisition management sub-process was correlated to time and to document flow. Like the budget sub-process, it followed the pattern of a substantial peak in the number of documents transmitted in the critical October through December 1985 period. Internal acquisition management documents were most prevalent and incoming documents second.

The contracting sub-process, however, was the greatest contributor to the ADF Competition decision making process. It was as part of the contracting sub-process that the Program Manager handled 36.43% of the internal documentation, 27.91% of the incoming documentation, and sent out 20.16% of all documents. Contracting was the only sub-process to correlate with the information search task as well as identification of alternatives, and alternative evaluation problem solving steps. The contracting sub-process also provided information about modeling and made brief mention of probability.

Therefore, the Program Manager relied primarily upon the contracting sub-processes with lesser support from the acquisition

management sub-process. The nature of the procedural requirements of these two sub-processes determined the timing and high level of internal coordination carried out during the decision making process.

The ADF PM also demonstrated the need to coordinate information internally while also receiving from other external organizations the information needed to accomplish its decision making task. This finding substantiates the need for the Supporting Level of the ODAM and supports the need for the Organizational Level interface.

The level of document flow was found to be significantly related to time. Internal documents, for instance, would tend to be more frequent in some months rather than others. Similarly, intra-organizational coordination was found to be related to time. These results underscore the importance of gaining an internal organizational consensus. The observed frequency tables show this to be particularly so in the unsolicited proposal evaluation phase and in the three month peak period just before the draft RFP release.

Extra-organizational coordination was also correlated to time. However, it exhibited a peak in the level of documentation that differed from intra-organizational coordination. Extra-organizational coordination was lacking in the April - May 1985 period but continued after the October to December 1985 peak, with higher levels lasting until March 1986.

In summary, various subcategory comparisons were accomplished to focus on the actual workings of the ADF Competition

decision making process. First, the flow of documents was related to the four acquisition sub-processes, the communication tasks and the five problem solving steps. The contracting sub-process dominated the ADF Competition program management documentation. Contracting documents supported information search activity and provided identification of alternatives and alternative evaluation information. The contracting sub-process was found to be most active with respect to internal coordinating activity and incoming documents from external organizations. The internal documentation flow was a probable reaction to the technical complexity of the ADF program while the external coordination was probably due to the complex management structure and powerful political influences. Overall, coordination appeared important as the primary means used to deal effectively with the complex situation facing the ADF Program Manager.

Given the strong compatibility of portions of the ADF Competition with the structure of the ODAM, it is recommended that the Air Force implement a formal method to track acquisition program documentation across sub-processes. Such a tracking method, based on the ODAM, would help the overall organization deal with the complexity of modern weapon system acquisitions as well as the dynamics of defense management in general.

The objective of the tracking system would be to document the agreement between the Program Manager and the overall organization about what the program will be in the future and why. The program management tracking system would provide the

organization with a single document that focuses not on what the program is (i.e. a baseline or PMP), but instead defines for program management what the program is intended to be. Anticipated benefits arising from the program should be tracked back to an unambiguous method (e.g. a model) that relates specific assumptions and agreements about goals, objectives, alternatives, values, methods of evaluation, and the state of influential environmental factors to desired outcomes and the tasks necessary to produce them. As in the ODAM, the institutionalization of such a system would result in more relevant advanced planning, more effective action, and more efficient management control.

It is also recommended that additional studies be conducted to validate the model. These studies should focus on different types of decisions, more precise variable definitions, and a greater variety of data sources.

Implementation of Model. The third objective of this study was to draw conclusions about the possible implementation of the ODAM into the acquisition management arena for use by Air Force program managers. This objective was met by comparing the category of critical decision analysis tasks with the other categories in the content analysis scheme (See Figure 11).

The intent of this objective was to determine whether there was any existing support (i.e. information generation activities and products) for decision analysis already available in the overall weapon system acquisition process. The results showed that half of the eight critical decision analysis tasks could be supported through

existing procedures, although the ability to determine the degree of fit was not possible. Those tasks addressed were: identification of outcomes, statements of preferences, definition of variables and use of quantitative models. These four tasks provided some of the information needed to support step 1 (Basis Development) and step 2 (Deterministic Structuring) of ODAM's Managerial Level decision analysis cycle.

Table 17 summarizes the comparisons of the four acquisition sub-processes with the eight decision analysis tasks.

Table 17

Sub-Process versus Decision Analysis Tasks

	Requirements	Budget	Acq. Mgt.	Contracting
Outcomes	•	•		
Preferences	•			
Variables				•
Models			•	•
Probability				
Uncertainty				
Value				
Risk				

• Correlation existed

The remaining four decision analysis tasks were not shown to be correlated to any of the sub-processes. Also, the volume of documents addressing these last four was very small, sometimes only one or two total documents. Also, it was these tasks that

would have provided the information necessary for the PM to understand the impact of future uncertainty on the program.

This study did not investigate certain areas that may have contained information about these tasks. For instance, classified documents were excluded from consideration and might have included statements about uncertainty or organizational values. Similarly, computer simulations used to support the ADF Competition could not be included and might have included information about probabilities, values, etc. However, the fact remains that the ADF documentation made virtually no reference to these subjects. Therefore, since the four decision analysis tasks of uncertainty, probability, values, and risk were not correlated, it appears that the ADF Competition decision was made while minimizing the affects on the outcomes of an uncertain future.

It is recommended that the Air Force investigate ways to inject the explicit determination, specification and consideration of uncertainty and risk into all management processes. Additionally, the information about uncertainty and risk that is produced should be made an integral part of all program documentation including program review presentations to facilitate discussions among the larger Air Force acquisition community.

Decision analysis inherently provides structure to data. This structure increases understanding of the problem and clarifies what decision is to be made, thus focusing the Program Manager's decision making efforts and clarifying issues to the broader organization. In a manner similar to the Requirements Correlation Matrix in the

recently revised SON procedures, the structure provided by the ODAM would allow the PM to track over time, in an integrated fashion, the status of all key decision variables. If a key decision variable were to change, it would then be easier to generate new alternatives and evaluate them consistently with earlier evaluations which would then in turn increase the Program Manager's ability to explain or justify any resulting technical or programmatic changes to the program's constituencies. This focus should improve the quality of both the communication which accompanies a decision and the specific action which results from the decision.

Summary

The use of decision analysis techniques within an overall normative decision making model can assist Air Force Program Managers in allocating the scarce resources of money, time, and manpower effectively and efficiently. A framework such as the ODAM provides the Program Manager with a method to manage complex processes, factor uncertainty into decision making, make communications more effective and improve post-decision management control.

The ODAM ensures that decisions are adequately defined, rationally consistent, and defensible to others. To the extent that these principles are implemented along side the existing management processes faced by the Program Manager, the overall management of the weapon system acquisition process can be improved.

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Captain Thomas M. Parsons was born on 3 August 1951 in Binghamton, New York. He graduated from high school in 1969. In 1970, he enlisted in the USAF and subsequently served in Texas and West Germany in Accounting and Finance. Upon discharge in 1977, he returned to college and in 1978 he received a Bachelor of Science degree in Management from the University of Maryland. In 1979, he received a commission in the USAF from the Officer Training School. From 1979 until 1983 he served as a program control officer and program manager while stationed at Brooks AFB in the Aerospace Medical Division. In 1984, he was assigned to Wright-Patterson AFB where he worked as a program manager in the Directorate of Development Programs, Deputy for F-16. Captain Parsons reported to the School of Systems and Logistics, Air Force Institute of Technology, in May 1986.

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Abstract

Program managers are faced with the task of integrating a complex mix of goals, objectives and procedures from four sub-processes within the major weapon system acquisition process. These sub-processes include needs determination, budget, acquisition management, and contracts. This complexity is compounded by the dual roles of the program manager: traditional manager coupled with primary program advocate.

To be effective in this organizational situation, the program manager requires a framework to efficiently guide decision making efforts. This study developed a normative decision making model to guide program managers in dealing with this complexity. The model, based upon management theory, focused on information generation and communication tasks. It was then compared to the Air Defense Fighter Competition decision.

Decision analysis techniques were integrated into the model to structure the decision making process to efficiently generate relevant information in a form to maximize its utility to the organization as a whole.

The case study evaluated Air Defense Fighter program documentation to ascertain applicability of the model. Analysis showed that a valid normative model can be developed for use by a program manager working in a bureaucratic organization; that the various sub-processes generated some of the information required by decision analysis techniques, but that information regarding organizational values and assessments of future uncertainty and risk were not used or requested; that coordinating activities were a critical part of efforts to reach consensus concerning goals, objectives, etc.; and that the sub-processes did not provide an overall coherent decision making structure.

Recommendations were that the Air Force initiate training programs in organizational decision making; that program managers be required to structure decision making activities to generate and document information in accordance with the normative model; and that methods to explicitly consider value, uncertainty, and risk be studied and implemented.